A DECISION SUPPORT MODEL FOR MOBILE TECHNOLOGY ENHANCED TEACHING

By

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ABSTRACT

Acquiring new knowledge and key skills in an educational setting is important to develop and improve education quality by integrating technology with teaching and learning in the curriculum. The choice of technology will be the principal focus of innovative Mobile Learning Technology (MLT). Developing countries have difficulty in adopting technology enhanced-teaching approaches due to a lack of technological resources, lack of appropriate guidance and training for teachers and school managers. It is necessary to assist teachers in determining appropriate mechanisms for delivering curriculum and utilising technology for teaching activities. The aim of this research is the development of a decision support model of mobile learning technology used for teaching to guide and assist teachers in determining appropriate mobile technology usage mechanisms for teaching and assist school managers in developing and designing the curriculum to be undertaken in the primary school environment.

This research collected and analysed data for the requirements of mobile technology-enhanced teaching and developed a novel decision support model of mobile technology-enhanced teaching to guide in planning and delivering curriculum using mobile learning technologies. This study employs a mixed methods approach (quantitative via questionnaire and qualitative via semi-structured interviews) administered in urban and rural areas, in order to identify and analyse data from the teachers' and school managers' perspectives on the requirements, and attitudes of mobile technology enhanced-teaching. The results highlight that guidance and training in using mobile technology are necessary for teacher training and for school managers delivering the curriculum. Therefore, teachers and school managers need an appropriate decision support model of MLT to guide and decide when they have to use MLT in order to maximise the use of MLT effectively. Soft System Methodology is used for investigating an unstructured problem and developing a decision support model for this research. Additionally, the testing and evaluation of the effectiveness, efficacy, and efficiency of the experimental model in a real-world environment were collected. Finally, this research develops a novel decision support model for mobile technology-enhanced teaching, which can

significantly increase the performance of teachers and school managers in planning and delivering educational systems suitable for teaching with mobile learning technology in primary education in Thailand.

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DECLARATIONS

I would like to declare my thesis that:

- I have written this thesis by myself.
- The thesis has not been submitted to other universities before.
- During the thesis preparation, some parts of thesis that were transferred to poster, paper and I have done were presented as following listed below:
    - Poster present in topic A Decision Support Model for Mobile Learning Technology Enhanced Teaching in Limited Resource Area. The poster was published in the Graduate School Conference and Network Event on 21 April 2016 and in Faculty Research Week on 9 May 2016
    - Chapter 4 present findings of questionnaire in topic The Attitude towards the Use of Mobile Learning Technology Enhanced Teaching. The paper was published in the DESE 2017 conference proceedings.
    - Poster present in topic The Attitude of Using Mobile Learning Technology Enhanced Teaching. The poster was published in the Woman Day Research on 8 March 2018
    - Poster present in topic Evaluation of the Requirements for Mobile Learning Technology Enhanced Teaching. The poster was published in the Faculty Research Week on 14-18 May 2018
    - Chapter 4 present part of the findings of Semi-structured interviews in topic Development of a Preliminary Model Guide for Using Mobile Learning Technology in Resource – Limited Primary Schools in Thailand. The paper was published in the DESE 2018 conference proceedings.

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ABBREVIATIONS

MLT	Mobile Learning Technology
SSM	Soft System Methodology
CATWOE	Customer, Actor, Transformative, Weltenschauung, Owner, Environment analysis factors of Soft System Methodology
SPSS	Statistical Package for the Social Sciences
Wi-Fi	Wireless Fidelity
ETHICS	Effective Technical and Human Implementation of Computer-Based Systems
VSM	Viable Systems Model
SSADM	Structured Systems Analysis and Design Method
DSS	Decision Support Systems
DSM	Decision Support Models

Chapter 1 Introduction

The structure of this chapter presents the research introduction that motivated the initiation of this thesis. The chapter also presents the research aims and objectives. The chapter discusses the research question of the thesis. The chapter also presents the structure of each thesis chapter.

The research context is primary school education in developing countries, in this particular instance, Thailand. In this information technology era, the use of mobile devices, such as Personal Digital Assistants (PDAs), Mobile phones and Tablet PCs, is becoming widespread and increasingly popular. In an educational setting, it can be used to provide learning opportunities, learning advantages, and learning activities for students in primary school. Acquiring the knowledge and skills to be a technologically effective member of society can start at a very young age, especially in primary school education. Therefore, mobile learning technology has been introduced in primary school education in order to reduce problems concerning the time and place of learning (Chen & Chung, 2008). According to Dr Nicholas Negroponte who is a founder of the idea of distributing low-cost laptops to children in developing countries in the form of the “One Laptop Per Child” project. This project was successful in terms of increasing attendance, and motivation. (Keengwe & Bhargava, 2014). Considering the Thailand National Economic and Social Development Plan Volume 11 focuses on the need to develop Education Equality and Improve Education Quality in both urban and rural areas (NESDB, 2013), Thailand’s government launched the “One Tablet per Child” (OTPC) policy in 2012-2015 through the Ministry of Education. They have distributed tablet PCs to every student in the primary schools with the purpose of improving the quality of education and providing a new learning and teaching model in order to promote students’ learning and teachers’ teaching by employing mobile technology in learning. The government and the Ministry of education decided to develop and improve education quality by integrating technology with teaching and learning in the curriculum. The choice of technology will be the principal focus of innovative ***mobile learning*** techniques.

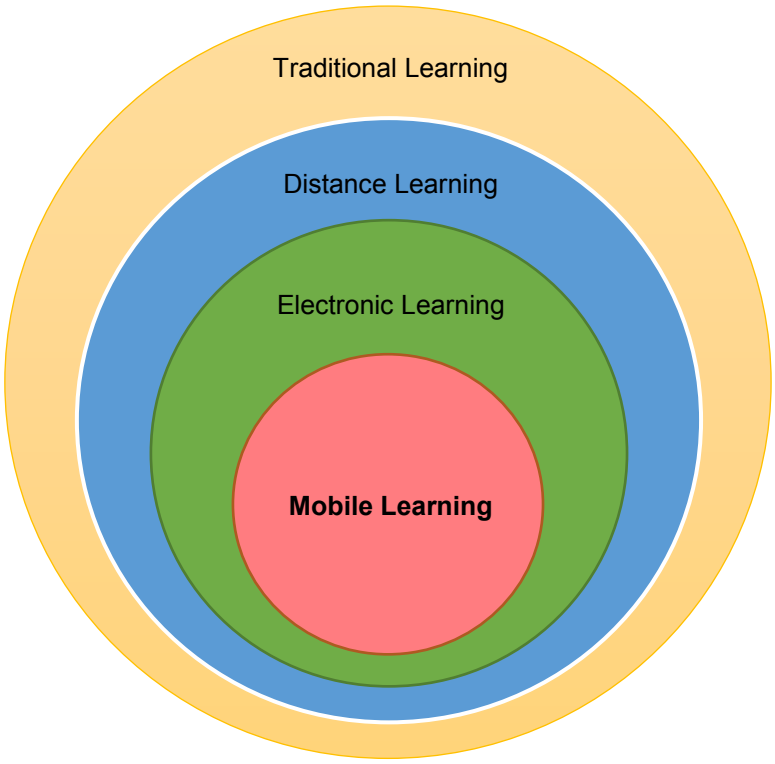

Figure 1.1 The position of Mobile learning as part of e-learning and distance learning (Adapted from Georgiev et al. 2004)

Figure 1.1 shows the position of mobile learning. It can be explained that the traditional learning is learning in the classrooms where teachers use textbook and learning material to students. Distance learning is a remote learning without face-to-face interaction with teachers in the classroom. Electronic learning is offered as a new method for distance learning by using computer and Internet technologies. This research focuses on mobile learning which is a part of e-learning and distance learning. Mobile learning is based on mobile devices, wireless internet connection, and available anytime anywhere, which decrease the limitations of traditional learning, distance learning, and electronic learning (Barzegar, 2016; Georgiev et al., 2004).

Some of the educators in developing countries will encounter the challenges of mobile technology usage. They will need to realise that learning with technology is important. Mobile learning technology can help students to participate actively in achievable, useful, relevant, and stimulating tasks to meet the challenges of the education system. To accommodate this, primary school educators will need to adopt current and suitable technologies in their approach

to teaching. However, even in societies with good socio-economic status, they may encounter some difficulties in the process. For instance, there are differences in local governance that give rise to poor technological resource availability in some areas. The availability of technological resources is an important element of the success of curriculum delivery. Additionally, preparedness, adequate guidance, and training are considered crucial and can enhance the use of technologies (Wiesenmayer, Kupczynski, & Ice, 2008). It can be assumed that the lack of appropriate guidance for educators is limiting the best use of the technologies that are available to them.

Some of the technologies that are available to school educators are mobile technologies. Mobile learning technology approaches can provide learning benefits to students and support school teaching. The use of mobile learning technology will be considered a crucial element of the delivery of the primary school curriculum. However, in order to maximize the use of this technology, the teachers should follow a model guide. This guide should be well defined and well thought out, and it should be developed using a proven methodology based on the real situation on the ground and cannot be ad-hoc.

Therefore, the objective of this study is to determine and develop a decision support model guide for using mobile learning technology appropriate for primary schools teaching. This can be used to enhance teaching activities and to assist educators in determining appropriate technology usage mechanisms. This research relates to primary schools utilising mobile learning technology, which is currently delivered in a wide variety of educational contexts of digital learning in Thailand and other developing countries.

The research presents the process to develop a decision support model guide for using mobile learning technology. The process uses Soft System Methodology (SSM), which is a well-proven tool for investigating an unstructured problem such as the one considered in this research. For example, Lewis (1993) stated that SSM had been used to conduct complex problematic situations from various participants' viewpoints. Additionally, Checkland (1981) confirmed that SSM could be used to organise the problematic, which is an unclear problem or solution. The aim of this research

is to develop a decision support model of mobile learning technology in order to help enhance teaching activities and concerns mobile learning technologies for supporting the primary school teaching that assist teachers in determining appropriate mobile learning technology usage mechanisms and assist school managers in developing the curriculum will be undertaken.

1.1 Motivation for the Research

The motivation for this research study is the investigation of the use of mobile learning technology in primary school teaching. In developing countries, mobile learning has been increasing due to the number of mobile devices being used. Hence, developing countries have trouble in adopting technology-enhanced teaching approaches. According to, Yusof et al. (2011); Mohd Yusof et al., (2014) stated that teachers face problems and challenges in using technology enhanced-teaching because they have limited knowledge and lacked the knowledge, experience, and skills of how to integrate the use of mobile learning technology into their teaching. As a result, most teachers do not know how to use mobile technology for learning effectively, so, it is important to investigate ways of using mobile learning technology for teaching. Regarding effectively using mobile learning technology-enhanced teaching, an appropriate guidance and training plays a significant role for educators to plan before use. To facilitate teachers' competence, increase teachers' preparation in using mobile learning technology, and training in designing an appropriate curriculum for mobile learning technology usage, this research study will consider factors to employ mobile learning technologies, to improve curriculum delivery for younger students in the context of developing countries. Therefore, in order to maximise the use of this technology, the purposes of this research focuses on analysing the parameters associated with technology-enhanced curriculum delivery. To develop a decision support model to assist educators in determining appropriate mechanisms for delivering curriculum and utilising technology for teaching activities.

1.2 Novelty and contributions

Overall, there has been a variety of mobile learning technology used throughout the world. The majority of previous existing academic research into mobile

learning has concentrated on the value of the use of mobile technologies for students' learning, for example, creating applications and systems for using mobile learning technology, examined perception during the use of MLT, comparative effectiveness and productiveness, evaluate learning outcome, and comparing different lesson methods. According to Wu et al. (2012), a systematic review of mobile learning technology trends was undertaken. They found that from 164 studies, effectiveness evaluation was the most studied of mobile learning technology trends (58%) and focused on creating mobile learning systems such as evaluating the mobile learning effects and studying the perception during the use of mobile learning (Crompton et al., 2016). It can be seen that most analyses investigated the comparative effectiveness, productivity, and learning outcomes across different academic subjects or different lesson methods. This research examines the perspectives of teachers and school managers in the use of mobile technologies for teaching and analysis of the current practice of mobile learning technology enhanced teaching. The novelty of this research is the development of a decision support model that provides an optimal procedure to guide teachers in planning and guide school managers in delivering the use of mobile learning technology in the context of primary school education in Thailand. Including a set of educational and technological parameters to determine appropriate technology usage mechanisms in each given setting. In particular, this research involves the following novelty and contributions:

- A new analysis of the current practice of mobile learning technology enhanced-teaching.
- A new perspective examination of teachers and school managers in terms of using mobile learning technology for teaching and delivering the curriculum.
- A new decision support model for choosing to create a new curriculum delivery system.

1.3 Research Questions

This research study is interested in exploring the model that is appropriate for using mobile learning technology for teaching in education. The following research study questions are:

1. How can the decision support model help to support the use of mobile learning technology for teaching?
2. How to use a decision support model for supporting the use of mobile learning technology for teaching?

1.4 Aims of the Research

The aim of this research is the development of a decision support model of mobile learning technology suitable for primary schools teaching in order to enhance teaching activities and to assist teachers and school managers in determining appropriate mobile learning technology usage mechanisms.

1.5 Objectives of the Research

The objectives of this research are as follows and shown in Table 1.1 below:

1. To complete an in-depth literature review in the areas of mobile learning technologies for elementary school teaching.
2. To collect and analyse data for the requirements of mobile technology enhanced teaching.
3. To develop a novel decision support model of mobile technology enhanced teaching to guide in planning and delivering curriculum using mobile learning technologies.
4. To test and evaluate the effectiveness efficacy and efficiency of the experimental model in a real-world environment.

Table 1.1 Research Objectives

Research Objective	Methodology	Chapters
Literature Review	**Secondary Data** - Related research - Documents, Books or media	**Chapter 2**
Identification of Problem	**Secondary Data** - Related research - Documents, Books or media	**Chapter 4**
	Primary Data - The findings of questionnaires in analysing the teaching methods and techniques of the use of mobile learning technology in the classroom.	
Data Collection Procedure	**Primary Data** - Questionnaires (online and paper- based) - Semi-structured Interviews (face-to-face)	**Chapter 3**
	Secondary Data - Related research - Documents, Books or medias	
Data Analysis Technique	**Primary Data** - Questionnaires - Semi-structured Interviews	**Chapter 4**
Soft System Methodology	**Primary Data** - The results of Semi-structured Interviews **Secondary Data** - Related research - Documents, Books or medias	**Chapter 5**
Model Development	**Primary Data** - The results of questionnaire and semi-structured interviews	**Chapter 5**
Evaluation	**Primary Data** - The results from Evaluation Questionnaire	**Chapter 6**
Research finding, Discussion and thesis writing	**Primary Data** - Research Results	**Chapter 7**
	Secondary Data - Documents, books	

1.6 Thesis Structure

The structure of the thesis is as follows:

- Chapter 1 – Research Introduction: This chapter will provide the research motivation, research novelty, research question, aim, objectives, and also thesis structures.
- Chapter 2 – Background and Literature Review: Review background of mobile learning technology includes Electronic learning (e-Learning) and Mobile Technology. Later, more critical literature review will associate with Mobile Learning (M-Learning) consists: the definition of mobile learning technology, benefits of M-Learning, limitations of M-Learning, and the development of Mobile learning models, the use of mobile learning technology to supplement traditional classroom teaching, Technological Approaches, Soft System Methodology (SSM), and summary.
- Chapter 3 - Research Methodology: Describes the detail of the methodology related to Soft System Methodology (SSM) including research design, methodology used, and participants.
- Chapter 4 – Results: This chapter provides the findings of the studies of this research. First, the quantitative studies' results (Pilot study) are presented to show the initial need in using mobile learning technology. Second, the results from qualitative studies are showed, based on the thematic analysis conducted in semi-structured interviews focusing on key themes and sub-themes.
- Chapter 5 – This chapter presents the outcomes of each stage of Soft System Methodology techniques used for development the decision support model. The results from chapter 4 are employed to create and develop a decision support model for the use of mobile learning technology in primary school. In addition, the results of tests and evaluation of the model in terms of the effectiveness, efficacy, and efficiency of the experimental model are presented.
- Chapter 6 - A proposed decision support model to support mobile technology for teaching. This chapter will explain the recommendation

to propose, and evaluation of a decision support model of mobile learning technology development.

- Chapter 7 - Conclusion: In this chapter, the research study is summarised with the overall findings, critical discussion, along with limitation and future work details.
- References
- Appendices

1.7 Summary

This chapter presented the research introduction, the research motivation, and also presented the research novelty. Furthermore, this chapter has presented the aims and objectives of the research and outlined this thesis structure. The following chapter will present the literature review, which concerns the area of mobile learning and related research.

Chapter 2 Background and Literature Review

Introduction to Chapter

This chapter provides a literature review relating to mobile learning technology, in order to understand the background of this thesis. The chapter reviews existing mobile learning technology models.

In line with the research title “A decision support model for mobile technology enhanced teaching”, this literature review consists of six parts namely: 1.Background of mobile learning technology 2. Mobile Learning (M-Learning) includes: the definition of mobile learning technology, benefits of M-Learning, limitations of M-Learning, and the evolution of M-learning models. 3. The use of mobile learning technology to supplement traditional classroom teaching, 4. Technological Approaches 5. Soft System Approaches, and 6. Summary

2.1 Background of mobile learning technology

2.1.1 Electronic Learning (E-Learning)

E-learning can be defined as distance learning or learning combined with electronic devices (Caudill, 2007) allowing students to learn or study at any time, in any place (Sarrab et al., 2013) and can be effective to support different modes of delivery (Bell & Federman, 2013). Motiwalla (2007) stated that electronic learning had become learner-centred. Welsh, Wanberg, Brown, and Simmering (2003) defined e-learning as learning by using computer network technology, originally using an Intranet or the Internet in order to transfer data, information, and instruction to persons (individuals).

2.1.2 Mobile Technology

Mobile technologies have potential as a supportive mobile learning tool between teachers and students, which can be used to support teachers in teaching and support students in learning.

Mobile technologies have become increasingly widely used, it can be said that one of the fastest growing technologies is mobile technologies, which are currently penetrating into daily lives (Hirsch & Ng, 2011). Sharples (2000) identified that mobile technologies can be used in learning as, 1) an intelligent assistant system that can be used to help students in learning. 2) Simulators and learning tools as additional learning material. 3) System devices and resources. 4) Communication devices can help to present information. Moreover, 5) simulation classrooms that show as a model of interaction between teachers and students. Mobile devices such as smartphones, PDAs, and tablet PCs are reasonably priced, portable and allow more flexible usage compared with desktop PCs. In addition, these devices are convenient and attractive for younger users who have familiarity with such devices and may become good teaching aids (Anshari et al., 2017; Mahamad et al., 2010). Mobile technologies can provide opportunities for new learning experiences and can access information in order to explore knowledge anytime and everywhere (Lam & Duan, 2012; Liaw et al., 2010). Mobile technology can support more interaction and can increase participation between pupils and teachers (Anshari et al., 2017). Similarly, Churchill et al. (2012) stated that mobile technology is effective in terms of its easy connectivity and its mobility (anywhere and anytime). Additionally, it is easy to use multimedia. In terms of developing countries, people are interested in mobile technology because it can be connected everywhere and increase the quality of their lives (Ally et al., 2014). It can be concluded that the capability of mobile technologies can allow everyone access to information anywhere and can remove learning barriers; particularly, teachers and students in remote areas can access teaching and learning materials from anywhere at any time (Ally et al., 2014; Keengwe & Bhargava, 2014). For example, in higher education, mobile applications such as Blackboard Mobile Learn, Blackboard Mobile Student, Microsoft office 365

(One Drive) can be used to share files, deliver contents and resources to students and can download files anytime. Bates (1997) believed that using mobile technology in education can improve the quality of learning, provide greater access to education and training, prove cost effective for education and can decrease the costs of education (Alexander, 2001). New learning approaches based on mobile technologies are collectively known as Mobile learning (Stead, 2005). Thus, mobile technology can assist and encourage learning participation among educators and students. In addition, mobile technologies encourage students to control their learning and they can create the learning goals by themselves (Boticki et al., 2015). It has also been shown that when students learn through mobile technology, they are more engaged in their classroom learning (Lu et al., 2014). This confirmed that mobile technology can be used as a learning tool in primary schools to support students' learning (Churchill & Wang, 2014). Additionally, Domingo and Garganté (2016) indicated the advantages of mobile technology used in learning, in that it can increase engagement to students' learning and provide a new tool for learning and teaching.

2.2 Mobile Learning (M-Learning)

In the previous section, E-learning and mobile technology has been discussed. This section will discuss mobile learning technology.

The use of technology to support learning is well documented. In particular, mobile learning technology is often used to describe using portable computers in education in order to support teaching and learning. Before developing a decision support model of mobile learning technology (MLT), we need to understand the use of mobile learning technology for teaching and the problems that may be encountered in primary education. Because in the previous research, there was little examination of the use of mobile learning technology for teaching and delivering curriculum, which is the gap covered by this research. In addition, the data has value for teachers and school managers in order to determine appropriate mobile learning technology usage. Therefore, this section will discuss a common definition, benefits, limitations, and the

development of mobile learning models in order to fulfil the development of a decision support model of mobile learning technology of this research.

2.2.1 Definitions of Mobile Learning

The definition of Mobile Learning or M-learning is a type of e-learning (electronic learning) that is delivered through the use of mobile devices and network connection such as handheld Personal Digital Assistants (PDAs), laptops, smartphones or tablets (Vinu et al*.,* 2011). Although the definition of electronic learning and mobile learning have a few differences, nevertheless, Mobile Learning is a new method of learning to aid interaction or promote collaboration between teachers and students (Mcconatha et al., 2008; Barker et al., 2005). In addition, Traxler (2005) compared the differences between e - learning and m – learning, which are different in the learning tool, communication methods and connectivity. Electronic learning uses desktop computing devices and the process of learning is in a specific location. In comparison, mobile learning uses mobile devices and the learning process is in a non-specific location.

Hwang and Tsai (2011) stated that the broadly perceived definition of mobile learning technology is “using mobile technologies to facilitate learning”.
Additionally Traxler (2005) identified the definition of mobile learning as:

“Any educational provision where the sole or dominant technologies are handheld or palmtop devices”. Regarding the definition of mobile learning technology, Traxler (2005) remarked that mobile learning technology could be used including mobile phones, smartphones, Personal Digital Assistants (PDAs), tablet PCs and laptop PCs. In addition Traxler (2005) defined mobile learning using other similar devices that “Perhaps the definition should address also the growing number of experiments with dedicated mobile devices such as games consoles and iPODs, and it should encompass both mainstream industrial technologies and one-off experimental technologies”.

Traxler (2007) has provided the following mobile learning definition:
“Looking at mobile learning in a wider context, we have to recognise that mobile, personal, and wireless devices are now radically transforming societal

notions of discourse and knowledge, and are responsible for new forms of art, employment, language, commerce, deprivation, and crime, as well as learning". Further, Traxler (2009) stated that "Mobile learning technologies clearly support the transmission and delivery of rich multimedia content".

Additionally, Winters (2006) has concluded the mobile learning technology perspectives in four factors as follows. (1) mobile devices and technology can support learning; (2) mobile learning is a subset and part of e-learning; (3) mobile learning is the use of mobile devices to complement and enhance traditional classroom education; and (4) mobile learning is an emphasis on student-centred learning as it relates to the mobility of the devices and mobility of the learner.

Attewell and Savill-Smith (2005) and Traxler (2007) on the other hand, defined M- learning as learning via wireless technology and digital devices that can be used anywhere and accessed anytime for supporting learning. In order to clarify the definition between e-learning and m-learning Jantjies (2014) and Traxler (2005) compared the differences between e-learning and m-learning. E-learning is an online learning process by using a computer network that has a specific location. Whereas mobile learning uses mobile devices that can interact and connect within many areas.

Vinu et al. (2011) supported that mobile learning can be accessed anytime, anywhere, on any device, any network, and any data. These learning technologies are productive because of the small size and light weight when compared with desktop PCs and other learning resources (Georgiev et al., 2004). In addition, it can provide opportunities and encourage pupils' engagement. This makes for convenience, easy access to data and immediate interaction between teachers and students. Consequently, the m-learning concepts that are used in the education learning processes use wireless network technologies to support flexible teaching approaches and reachability (Farooq et al., 2002). For example, Liu and Chu (2010) compared using ubiquitous games-based learning and non-gaming learning for English learning outcomes and motivation. The results of this study were that the usage of the

ubiquitous games succeed in learning motivation and had better learning outcomes than non-gaming usage.

Jan et al. (2016) found a positive attitude among students in using mobile learning technology in education. They have a strong liking and support mobile learning because the mobile learning can enhance students' learning in higher education that improves communication, enriches the experience of their learning, simplifies learning and saves time (Kafyulilo, 2014). Several mobile learning studies found that students and teachers agreed and preferred using mobile learning technology because it encouraged and motivated students' learning practices.

Similarly, mobile learning technology offers opportunities, and fosters interaction between students and teachers (Howard, 2002). It aids students to understand by themselves. Furthermore, mobile learning technology is a part of classroom learning, but for some students and teachers using mobile learning can be a challenge when compared with traditional classroom teaching (Clough et al., 2008).

Furthermore, in the context of using mobile learning technology in developing countries, mobile learning technology plays a significant role in improving education quality and supporting the learning environment.

Pimmer et al. (2014) investigated the use of mobile learning as effective educational tools in nurse education in South Africa. Sixteen nurses who were interviewed related to the use of mobile learning technology in this study pointed out the benefits of using MLT as "(1) authentic problem solving; (2) reflective practice; (3) emotional support and belongingness; (4) the realisation of unpredictable teaching situations; and (5) life-long learning" and these instruments are appropriate to communicate between students and teachers.

Mohd Yusof et al. (2014) studied adopting mobile learning in Malaysia, which considered teachers' perception of the use of mobile learning in education. They expressed that although in Indonesia, the use of mobile technology in

teaching such as game-based learning software and animation projects could be useful for their students in that MLT can save the preparation time.

Yusri, Goodwin, and Mooney (2015) examined teachers' perception in Indonesia of the willingness and readiness for engaging in the use of mobile learning. They revealed in their studies that 308 teachers in Indonesia had a positive perception of using mobile learning in that MLT can save them teaching time. The majority of teachers had been willing and ready for using mobile learning for teaching.

Although teachers and students typically have a positive perspective regarding using mobile learning technology, nevertheless, there are some concerns regarding the use of MLT to support teaching amongst students and teachers.

In the case of teachers, O'bannon and Thomas (2014) discussed the barriers to the use of mobile learning technology for teaching in the classroom. They argued that accessing inappropriate information is the primary concerns of using MLT, followed by making students distracted from the learning process. Kafyulilo (2014) expressed the view that using MLT in schools can distort students' behaviours, playing games during class hours, reducing students' capability for self-learning and reducing students' attention. Moreover, device issues are one of the obstacles for teachers in the use of mobile learning for teaching such as battery lifespan, small screen sizes and internet connection (Jantjies, 2014; Yusri et al., 2015).

Regarding the negative perspectives of students towards learning with mobile technology, Al-Fahad (2009) studied students' attitudes towards using mobile learning technology in school and found the negative perception of students related to external factors such as the quality of network connection. The connection might be poor that can impact with the time of learning.

2.2.1.1 Discussion

Regarding the overall definitions of mobile learning, it can be concluded that Mobile learning or M-learning is a new method for learning using portable

devices or mobile devices such as smartphones, tablet PCs that can assist the teacher in improving the methods for teaching and students can gain more knowledge by themselves. Mobile learning technology is learning with wireless networking. MLT can be used to facilitate, support, and enhance teaching and learning that can be attractive to both teachers and students. Allowing and assisting teachers and students to access and learn anywhere and anytime. MLT can provide opportunities for learning.

UNESCO (2013) reported that mobile learning could support teachers in school, and support learning throughout the world. In addition, Domingo and Garganté (2016) concluded that five advantages of the use of mobile learning technology in the classroom are: “providing a new way to learn, increasing engagement to learning, fostering autonomous learning, facilitating access to data, and promoting collaborative learning”. It can be concluded that mobile learning technology is a good learning tool for teachers in teaching; particularly in developing countries that it could be a useful tool and enhance the pupils’ learning in primary education.

2.2.2 Benefits and Limitations of Mobile Learning

In the previous section, mobile learning definitions were discussed. This section will discuss the benefits and limitations of mobile learning use in primary school.

2.2.2.1 Benefits of Mobile Learning

When Domingo and Garganté (2016) investigated teachers’ perception on the impact of the use of mobile learning technology in primary education, they found that there are two positive impacts of mobile learning technology in the classroom:

- Simplifying access to data and raising engagement to learning.

This point is similar to Amarnath (2018), who stated, the benefits of the use of mobile technology in learning are that:

- MLT is convenient for students in terms of easy access to learning anywhere and anytime.
- MLT encourages students’ engagement and doing activities together in the classroom. This can provide several opportunities such as:

motivating students to engage in learning by themselves, permitting pupils to make connections with a classmate on learning lessons, enhancing students' motivation to learn, immediate access to digital data such as video clips (Murphy, 2011; Furió et al., 2015).

For instance, when they do not understand the lesson but hesitate to ask teachers to describe it again, mobile learning can help them to revisit the lesson. It can be stated that MLT provides students with more opportunity for self-learning skills required for their studies. In addition, Corbeil et al. (2007) and Hartnell et al. (2008) agreed that:

- Using mobile phones in learning can facilitate students to access data.
- Students can collaborate with a classmate and teachers set up MLT as student-centred learning.

Mobile learning technology has various positive impacts and has positively perceived usefulness for both students and teachers.

It can be concluded that mobile learning technology has a variety of benefits:

- Will help to evaluate learning outcomes for students.
- Will promote students' capabilities in learning outside the traditional classroom.
- Will extend learning opportunities in time and location, providing an independent environment when compared with the traditional classroom (Korucu & Alkan, 2011).
- Can be delivered to tablet PCs and can motivate and encourage students to learn more and exchange knowledge with their colleagues (Barker et al., 2005).
- Mobile learning technology can provide ease of use and ease of access that helps students can learn anytime and anywhere.
- Mobile learning technology can reduce barriers to a learning environment, which can enable students to learn outside the classroom.

2.2.2.2 Limitation of Mobile Learning

In the previous section, we referred to the benefits of mobile learning. Although there are several benefits of mobile learning technology, there are also barriers to using MLT. In this section, we will explore the limitations of mobile learning technology. It can be said that, although there are a variety of benefits of mobile learning. However, a few limitations should be considered. Therefore, this section considers the limitations of mobile learning technology impacts related to use in classroom learning.

A number of limitations to using mobile learning technology appear in this section however, most of the limitations were normally external factors. According to Amarnath (2018) revealed that there are a few limitations of mobile learning.

- First, regarding the internet connection problems, for example, a poor signal for downloading the data.
- Second, the screen size of mobile devices is smaller than a personal computer or desktop computer that can give students eyestrain and fatigue if they look at their screen for a long time. Therefore, teachers have to set limits on using the devices.
- Third, relating to the variety of features and applications of mobile learning, the technology may distract students from focusing on learning, for example, students may access inappropriate data on the internet on their devices (Thomas et al*.,* 2014). The use of mobile learning technology for teaching shows that MLT can make the student distracted and disengaged in their learning.

Kukulska-Hulme (2007) discussed the usability problems of mobile technology for learning:

1. The physical problems of mobile devices, for example; screen size is small, memory is less and battery life is short.
2. Reliability and connection speed.

Similarly, teachers' perception in study of Oz (2015) revealed the limitations of mobile learning were the limits of memory sizes and poor potential of mobile learning for accessing information, individualised learning and lifelong learning.

Furthermore, Jisc (2017) stated that mobile learning technology definitely has some limitations. Here are some limitations concerning the use of mobile learning technology:

- Disabled students cannot use some mobile devices.
- Some content of the mobile learning technology may not be safe for younger students (e.g. inappropriate picture, pornography) (Jisc, 2017).

2.2.2.3 Discussion

This section has presented the benefits and limitations of mobile learning technology; benefits include increasing student communication, enhancing learning engagement, and immediately accessing data (Cheng et al*.,* 2016). Furthermore, the functions of mobile technology allow students can learn both in the classroom and outside the classroom. This leads to increasing students' learning time. Meanwhile, regarding the use of MLT by teachers, MLT can save preparation time for finding instruction tools and decreasing workload in that teachers can let students learn independently by using MLT. As a result, the effort of preparing learning materials for teachers is decreasing (Lu et al., 2014).

2.2.3 The development of mobile learning technology models

With regard to existing mobile learning technology models, all of the current mobile learning models are structured differently. Each model will be used to guide and to support the development of decision support model of MLT in this research. In this section, we will consider and review the existing mobile learning technology models in order to develop and design the decision support model of MLT to be used effectively and successfully in primary schools.

Jisc (2017) listed seven categories of activity that can be used for designing mobile learning technology models: Behaviourist, Constructivist, Situated, Collaborative, Informal, Lifelong Learning and Teaching Support. It concludes that one of the activity categories particularly suited to the design model in this research is “Learning and Teaching support, which is used to aid in the coordination of students who are involved with learning and resources for learning activities”.

Al-Hmouz and Freeman (2010) stated that the objective of a model is “to provide a logical structure for the process”. They studied adaptive models for mobile learning content, and presented a model that plays a significant role in delivering appropriate format of learning content approach to the students’ style. In this mobile learning content model, three processes (See Figure 2.1) were used to create appropriate mobile learning content as follows:

1. Teachers input the raw learning information into the mobile device.
2. The use of filters can be used to track information changes
3. Suggest content that is associated with learning activities and material

This model can support different learning and perspective of users, and additionally, can improve teachers’ and students’ engagement, increase learning experience, and can save time to learn and teach.

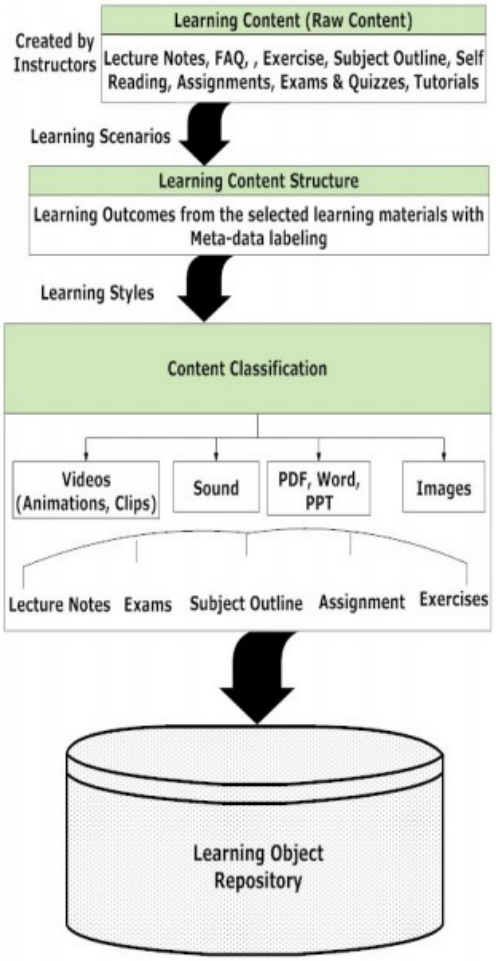

Figure 2.1 Modelling Process for Mobile Learning Content (Al-Hmouz & Freeman, 2010)

Fulantelli, Taibi, and Arrigo (2015) provide a task-interaction model to support decision making in mobile learning, which focuses on considering the students' interactions. There are six elements of the task-interaction model including context, tools, control, communication, subject, and objective as shows in Figure 2.2

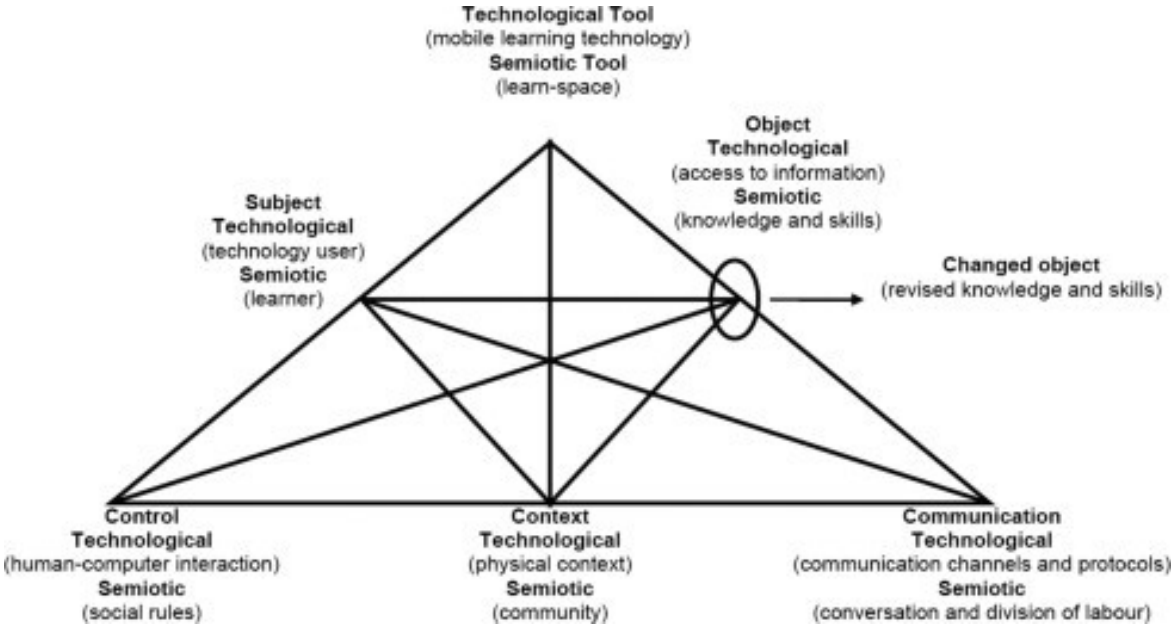

Figure 2.2 Task model for mobile learning (Fulantelli et al., 2015).

Regarding the task model for mobile learning, the six factors were described as **context** factor representing relevance of learning environment, **Tools** factor representing the pedagogic role of instruments used in learning. **Control** factor means the impacts on learning processes and goal that related to both students and teachers. **Communication** factor is significant factors for enhancing the knowledge, which represents the activities. **Subject** factor represents the learning scenario or the type of interactions. Lastly, **Objective** factor represents the level from knowledge to evaluate.

The potential of the task-interaction model is to support education decision making in mobile learning in terms of benefits, this model is used to support teachers in the analysis of mobile learning technology and provide new opportunities for students' learning.

Clough et al. (2008) explored informal learning, which is learning outside the classroom. It means learning from others without interaction' and 'collaboration' as self-learning (Grosemans et al., 2015). Clough et al. (2008) stated that informal learning is learning supported by technology devices such as smartphones and tablet PCs. This study designs a flexible model for mobile learning that is used to classify the learning activities suitable for learning. Additionally, the model can be used to support the development of mobile learning technology. The Clough et al. (2008) model included the main six elements for considering informal learning activities are referential, location aware, reflective, data collection, constructive and administrative. Then, it qualifies the learning activities with five categories: individual, collaborative, situated, distributed, and interactive.

As shows in Figure 2.3. This model concentrates on the context and explains a short consideration of mobile technology used in the learning process.

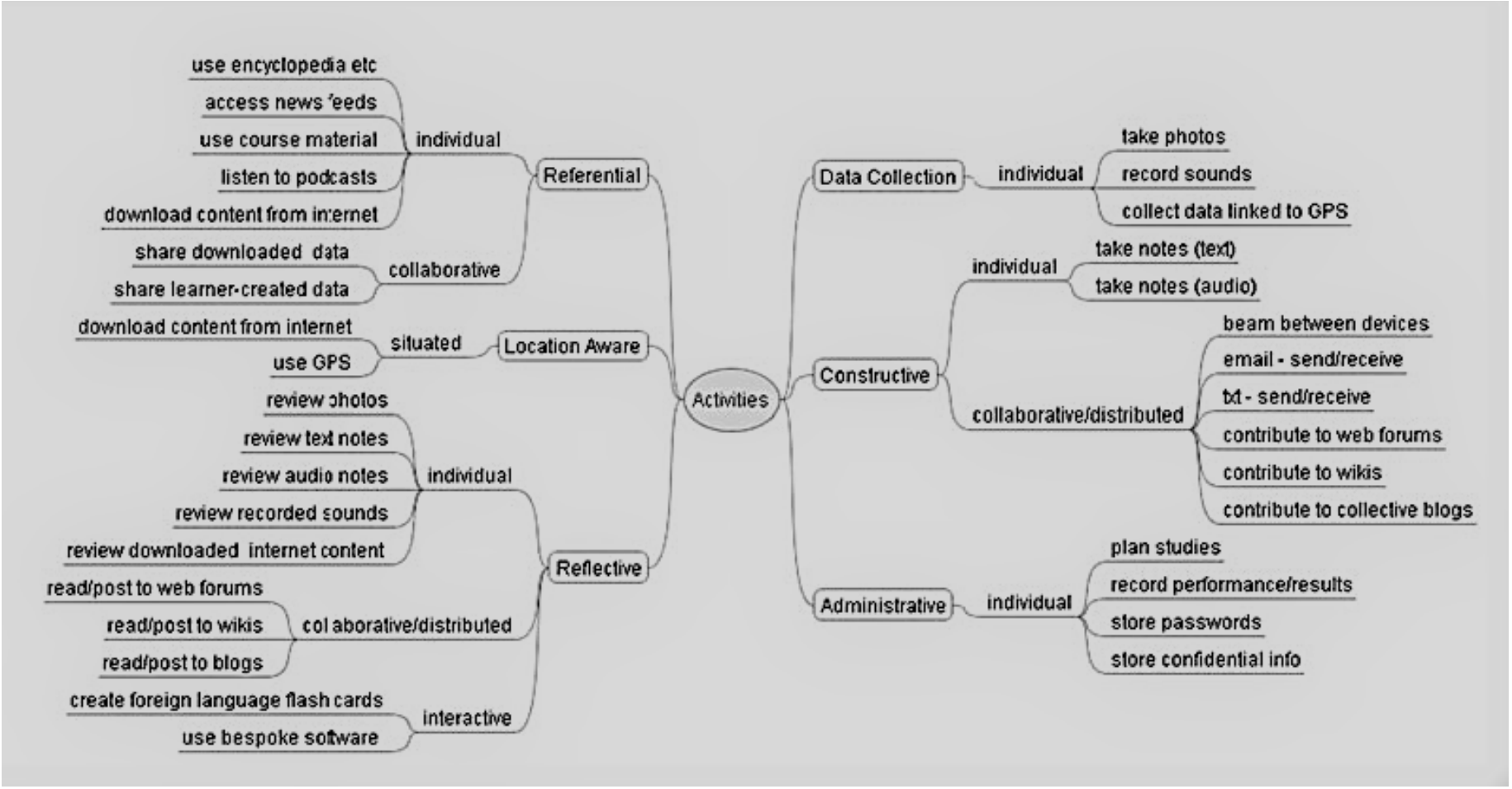

Figure 2.3 Informal Mobile Learning Model (Clough et al., 2008).

The Framework for the Rational Analysis of Mobile Education (FRAME model) was developed by Koole (2009) including three elements of mobile learning: devices aspects, learner aspects, and social interaction aspects as shown in Figure 2.4, which there are three circles representing three aspects (1) devices aspects, (2) learner aspects and (3) social aspects. All three aspects relate to mobile learning situations that can be used to create experiences mobile learning that are more effective.

The strengths of Koole's model was that it can be helpful for guiding teachers to develop learning material and to design teaching and learning to be more effective for using mobile learning technology in education.

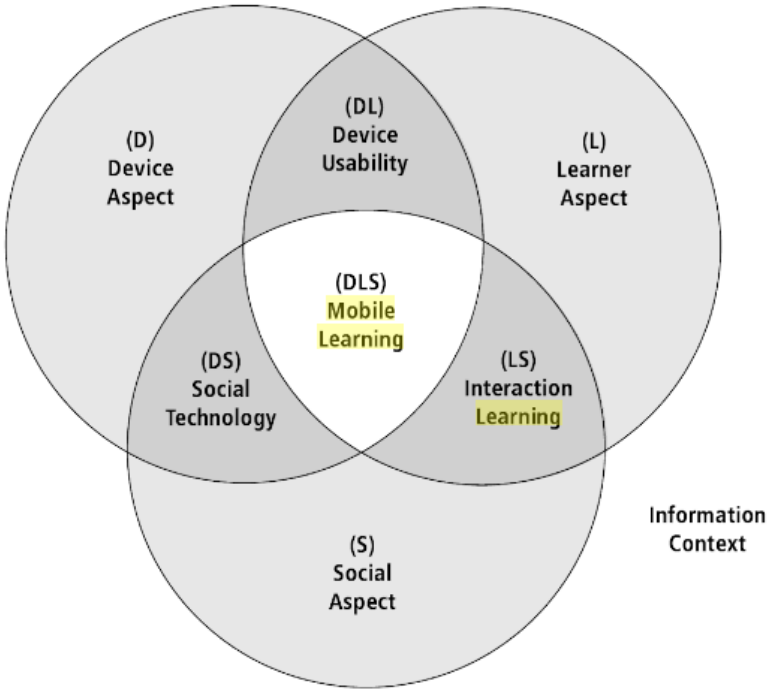

Figure 2.4 The Framework for the Rational Analysis of Mobile Education *(FRAME model) (Koole, 2009)*

Yusof et al. (2011) examined teachers' perception of blended learning in Malaysia, from their studies have emerged the conceptual model of blended learning in education that includes the 3Cs: Connection, Confidence, and Content, which have influence on the use of technology. The conceptual model is based on a discussion of the experience and knowledge of teachers who participated in the interview on blended learning environments. The conceptual model of blended learning defined the three key elements as mentioned above. In addition, there are three key words used to describe the experience of activities between teachers and students merging technology with learning, namely Know, Learn and Use. The model is shown in Figure 2.5 below.

The good points of the model helped us to more understand easily the relationship between teachers' experience, environment of learning and government policies' impact on using technology blending in the classroom.

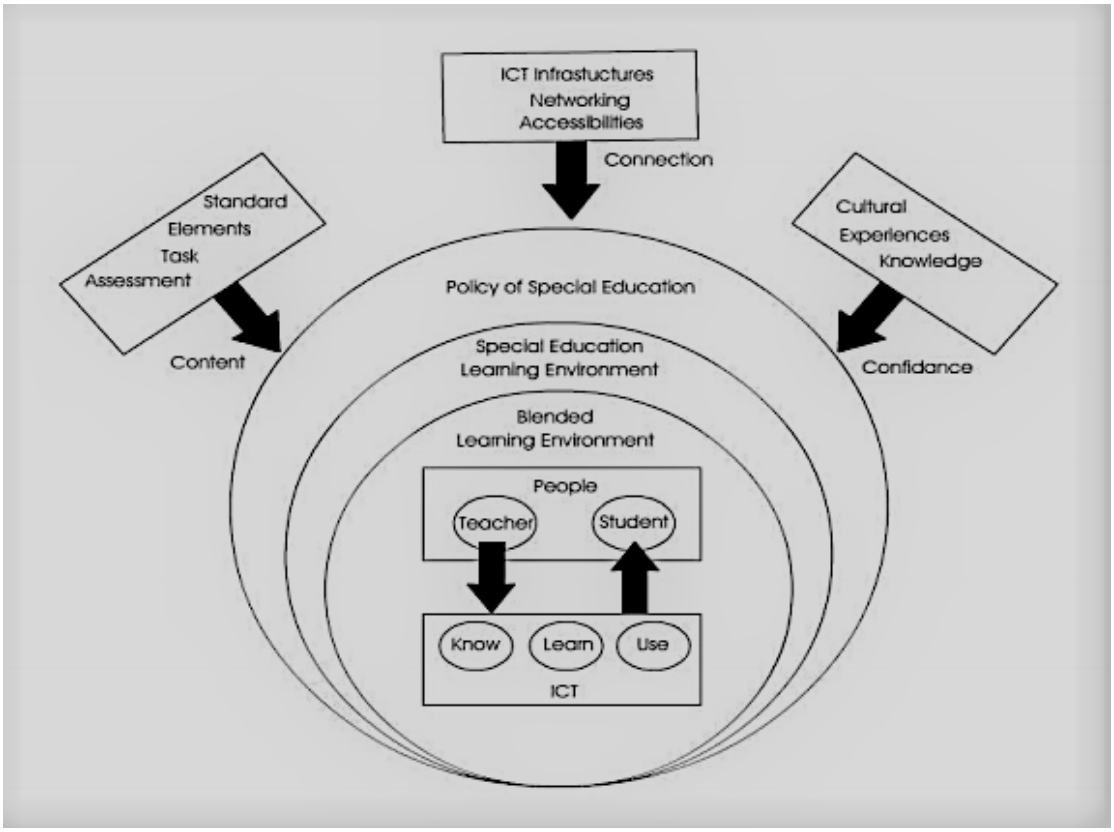

Figure 2.5 The Conceptual Model of Blended Learning in Special Education (Yusof et al. 2011)

Ng and Nicholas (2013) investigated a model that can be used for mobile learning technology in school. This model considers how to sustain the use of mobile learning in school (as shown in Figure 2.6). In addition, the model shows the effective integration of a mobile learning technology system into teaching and learning.

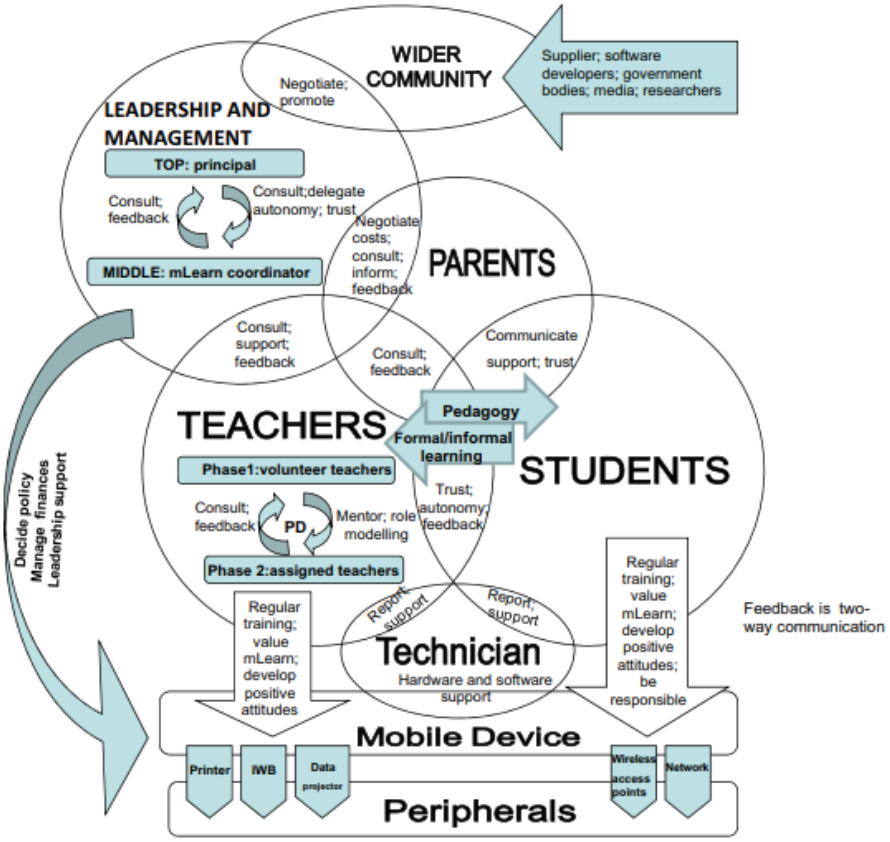

Figure 2.6 Model for Sustainable mobile learning in schools (Ng & Nicholas, 2013).

Figure 2.6 illustrated a model of mobile learning and it can be described as follows. The model presents the several stakeholders who were involved with the mobile learning system in school and their actions in the system. The stakeholders are leaders, and management who are the principal coordinators of mobile learning who have to work with teachers in order to create a learning environment with students. Teachers in this system are significant to the success and sustainability of the use of mobile learning technology in school. Students are involved with learning from mobile learning. The technician is involved with providing technical support and providing comfort in using mobile learning in teaching for teachers and parents (or the community) who are

involved in communicating and supporting the use of mobile learning. This advantage of this model is that it clearly considers the interaction between stakeholders (leadership team, community (parents), technician, teachers, and students).

2.2.3.1 Discussion

Overall the review of models concluded that each model has different advantages that can be used to enhance learning and teaching activities. The model can be used to help and guide the users for planning the use of mobile learning technology for teaching effectively.

To develop a novel decision support model of MLT, the models of Yusof et al. (2011) and Ng and Nicholas (2013) were selected to adapt in order to approach the decision support model of mobile learning technology for this research. Because their model was implemented in any technology, such mobile technology needs to be blended in the classroom and used in a sustainable manner for the use of mobile learning technology in schools.

Therefore, to propose this research model, this study will use the Soft System Methodology to develop and define the decision support model of mobile learning technology.

2.3 The use of mobile learning technology integrated with traditional classroom

In this section, we look at mobile learning technology that can support traditional classroom learning in the context of primary school education. Therefore, we will consider whether the mobile learning technology curriculum could play a role in supporting the traditional learning environment.

New technologies such as mobile technology may be introduced in school education. Keengwe and Bhargava (2014) examined case studies on integrating mobile learning technology in education. They pointed out in their studies that using mobile technology as educational tools as well as integration in the classroom learning, benefits the pedagogy.

Boticki et al. (2015) revealed that using mobile technology in the classroom can increase communication between teachers and students. In particular, they gain in learning because they can work together as a group with more discussion, and help each other. In many primary schools, most of the teachers are continuing to use traditional teaching methods in their classroom. Jantjies (2014) investigated whether mobile learning technology can support traditional learning. The study results revealed that when mobile learning technology is used in teaching, teachers can use the traditional curriculum to design activities of learning and plan the lessons for students. Sung, Chang, and Liu (2016) examined the effects of mobile devices integrated with teaching and learning in education. They analysed 110 experimental and quasi-experimental articles published during 1993 – 2013 and pointed out that overall using mobile devices appears to be useful for teaching and learning in the classroom. Interestingly, trends in the use of mobile learning technology and traditional learning increased markedly during 2008 and the trends were reviewed from 154 studies of mobile learning and ubiquitous learning published in journals from 2001 to 2010 (Hwang & Tsai, 2011). Christensen and Knezek's (2017) study relating to the integration of mobile learning in the classroom discovered that teachers have a positive perception and see a prospect of using MLT in the classroom. Their exploration of the readiness of integrating mobile learning technology in the classroom found that teachers were ready to adopt MLT integrated into the

traditional classroom. MLT integration in the traditional classroom is a significant factor to the success of the effectiveness of learning in the classroom. Similarly, a study of Brewer et al. (2005) also showed that integrating technology in rural area schools had provided a positive impact in using mobile technology in learning in the classroom.

Suanpang (2012) agreed that adopting mobile learning technology use in the classroom can be useful for assisting in sharing the knowledge and can also increase interaction or collaboration between teachers and students and between students and students in the classroom (Boticki et al., 2015). The study reported the perceptions of 1,121 teachers of using mobile learning in the classroom. Teachers were asked whether they supported the use of mobile learning in the classroom. The results showed that most of the teachers support the use of mobile learning technology in the classroom. Additionally they believed that MLT features could be a benefit for their school teaching (O'bannon & Thomas, 2014). For example, Ekanayake and Wishart (2011) examined how the mobile phone cameras can be used in teaching and learning, they found that using mobile phone cameras can assist teachers in lessons preparation. Furthermore, when they use the mobile phone cameras in the classroom, it can increase the students' interest, and improve interactive participation and collaboration.

Lu et al. (2014) examined learning Chinese characters via mobile technology in a primary school classroom. The results from their classroom observation found that teachers were successfully integrating mobile learning technology in the form of blending an application into the pedagogy in their classroom-learning environment. Students are well engaged in learning that involves integrating mobile learning technology into their classroom. They stated that four techniques where teachers used applications for integrating into the classroom learning are as follows:

1. Teachers combined an application with workbooks. They used a mobile tool for demonstration and allowed students to practice their handwriting.

2. Teachers used an application to identify the alphabet and allowed students to practice by using their tablets for practice. This would help students' cognitive ability in grammar and oral skills.
3. Teachers used an application to support students' learning in terms of using game-based for encouraging pronunciation and listening skills.
4. Teachers used an application for facilitating characters.

Keengwe and Bhargava (2014) stated that "the 21st century is the digital age where teaching and learning is not limited to traditional classroom" therefore, the use of mobile technology in learning is significant for innovation and makes education available worldwide and everyone can use it anytime and anywhere. Overall, the use of mobile learning technology supplemented the traditional classroom. It can be concluded that the use of mobile learning technology can be supplemented and supported in the traditional classroom. In order to successfully integrate the use of mobile learning technology in the classroom, teachers need an instructional conceptual model to guide them and need training to effectively use the mobile technology in learning to support students' learning in the classroom (Bitner & Bitner, 2002; Ertmer, 2005).

2.3.1 Discussion

Regarding the use of mobile learning technology blended with the traditional classroom, 79 teachers participated in a study of Thomas et al. (2013) that they studied about teachers' perspectives of using cell phones in the classroom. Their studied found that most of the teachers encouraged integration between MLT and the traditional classroom. Christensen and Knezek (2017) revealed in their study that for the successful integration of mobile learning technology in the classroom, teachers really need supportive training on the teaching. This will assist them to feel confident in using MLT in their classroom environment. Also when comparing the use of mobile learning technology as a tool with traditional classroom learning methods, they found that MLT can aid students in practice, and highly engaged, and motivated them more than learning with traditional classroom techniques (Lu et al., 2014). While Anshari et al. (2017) argued that there are some negatives in the use of mobile learning technology in the traditional classroom. For instance, MLT may contribute to distraction in

the classroom, lacking handwriting skills, and be reducing face-to-face interaction. To be effective, this is a reason why we will develop the decision support model of mobile learning technology.

To summarise, overall teachers use MLT to supplement traditional methods in the classroom in terms of an additional teaching tool. In the case of students, the functionality of the use of MLT is beneficial and can be used for enhancing students' learning in primary schools that is effective and enjoyable for them. MLT can be useful provided that they have discipline in using mobile technology in learning. Additionally, MLT can be useful for learning both individually and in groups. In the case of teachers, the MLT functions can assist teaching in terms of reducing the teachers' workload, can save preparation time, motivate students' learning, as well as increase self-confidence in their teaching. Consequently, MLT can challenge the traditional classroom-learning attitude of teachers and motivate them to change teaching practices by using MLT as a supplementary tool in the classroom.

2.4 Technological Approaches

This section analyses the technological systems in order to identify which technological methodology is appropriate to utilise and approaches within the development of decision support model of mobile learning technology for this research. We are beginning with an understanding of differences and conflicts between the Technical approach and Socio–Technical approaches. It then discusses which Socio–Technical approaches are appropriate for adopting within this research in order to develop a decision support model of mobile learning technology in primary school. Therefore, it is significant to understand the methodology that is used to develop the decision support model of MLT that contains relevant functionality, and is applied to problem situations.

There are two mains types of technical method systems, which are; technical approaches and socio-technical approaches.

2.4.1 Technical Approaches

The technical approaches are concerned with the tasks, technology, and system processes. The processes of technical approaches are inputs, processes, and outputs (Bygstad et al., 2010). They can be used in software development and focused on the physical aspect of the technology concept and the technical ability of the system. Examples of technical approaches are action research that emphasises mathematical techniques to find the best way to manage tasks. computer science, which is interested in creating theories and how computers work as software development such as Structuresd Systems Analysis and Design Method (SSADM).

Structured Systems Analysis and Design Method (SSADM).

Structured Systems Analysis and Design Method (SSADM) had also been adopted for an approach to design and analysis of information systems development (Ashworth, 1990; Kinloch, 2008). This method integrated several structured techniques by analysing the current system as logical design through the new system as physical design into a clear procedural model of each stage, each with design inputs and outputs, which have to be completed (Ashworth,

1990). Additionally, the basic SSADM techniques are used to produce and deliver from logical system design (hardware/software) to translate into initial physical system design in order to determine how a system of each step and task is to be performed (created) or updated. The SSADM elements include both top-down and bottom-up approaches to develop a particular system by using methods such as data flow diagram and logical data structure that can be used as a technique to plan data structure for generating a system during the SSADM stage (Ashworth, 1990; Kinloch, 2008).

SSADM implements the Waterfall model in order to develop and design systems that consist of six main stages where each stage is broken down into a number of sub-stages. The sub-stages define inputs, outputs and tasks to be carried out. Each stage has to be signed off as a baseline before the subsequent stage begins. The SSADM is feasible to develop a specific system, for example, analysis system in the business area in order to create a software/hardware system to address the organisation problem. The SSADM stage is shown in Figure 2.7 as a Waterfall Model.

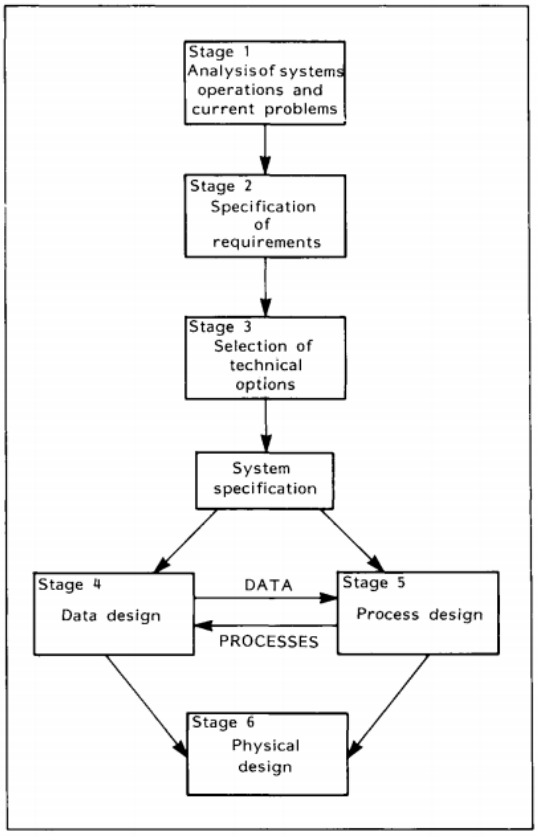

Figure 2.7 Stage of the SSADM model (Ashworth, 1990)

According to the SSADM model, during the requirements analysis (stage 1), problems are identified, and presented. Data flow analysis and logical data analysis can be used as techniques that will be chosen to refine the system.

During the specification of requirements, the data flow analysis, logical data analysis, and Entity event model analysis can be used as techniques, The requirements are particularly as a result of the previous stage.

In the meantime, the stage of logical system specification was developed and implemented. The logical data design was updated. Process design was examined in order to carried out through system dialogues.
Finally, the logic of data design, process design and system specification are utilised to generate a physical design of a system in order to set program specifications.

SSADM technique can be used for solving technical problems in order to help the developers to address the problem and prevent unnecessary constraints adding a stage in the development (Ashworth, 1990). In this research case, we have not designed or developed a programming system. Therefore, the SSADM would not be chosen to use as a methodology in this research.

In the previous section, we considered the technical approach, it can be seen that the technical approach would not be appropriate for utilising as a methodology in this research study. Consequently, in the next section we will discuss Socio – technical systems or Socio-technical approaches in order to demonstrate that their clarification is suited for this research.

2.4.2 Socio-Technical Approaches

The Socio – technical systems or Socio-technical approaches were originally from EMERY and TRIST (1960) who explained that the system aims to approach a complex interaction and to discuss the relationship between technical, human, social and environmental aspects of organisation. It aims to create and solve the problem that includes both social and technical factors in

order to achieve the balancing between users' satisfaction and the organisation system and provide equal weight to social and technical factors (Mumford, 2000). Therefore, the socio-technical are considered to use (Bygstad et al., 2010). Additionally, applying a socio-technical approach is introduced to develop an organisation system that can lead to organisation systems being more satisfactory to people who are involved within the organisation (Baxter & Sommerville, 2011). Therefore, the Socio-technical approaches are appropriate for this research study as it allows complex interaction between human and school environments where different viewpoints from people involve within the organisational systems can be investigated.

There are several socio-technical approaches, which will be analysed as follows; Soft System Methodology (SSM) by Peter Checkland (1981). Effective Technical and Human Implementation of Computer-Based Systems (ETHICS) by Mumford and Weir (1979). Multiview by Avison and Wood-Harper (1986), and Viable Systems Model (VSM) by Beer (1985) in order to clarify which one of the socio-technical approaches is suited for this research. As can be seen in the diagram of the Socio-technical approach in Figure 2.8.

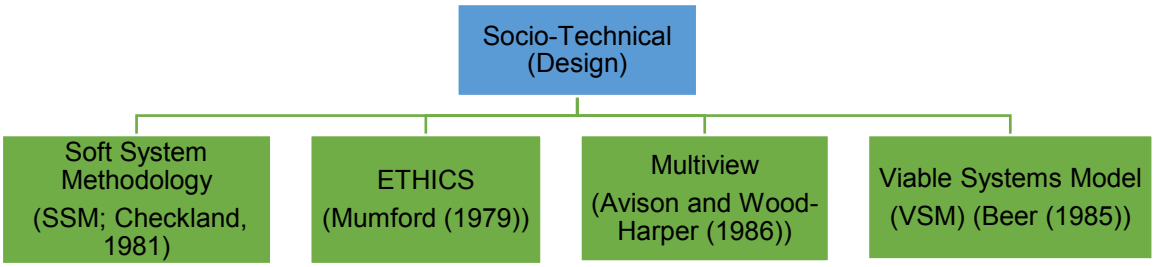

Figure 2.8 The diagram of Socio-technical approach.

Soft System Methodology (SSM)

Soft System Methodology (SSM) developed by Peter Checkland (1981) is a systems-based methodology that is used to develop systems thinking from action research. SSM is used to approach and solve a problem in messy unstructured problem situations, which developed through engagement with the human' problem situations (Checkland & Poulter, 2006; Checkland &

Scholes, 1990). The key feature of SSM is a methodology that concentrates on helping to solve a different problem from different stakeholders' viewpoints (people who are involved in the system) and developing an understanding of the problematic situations (Peter Checkland & Poulter, 2006).

The SSM is used when objectives or requirements are not fully defined by developing a solution to improve the unstructured problems through users who participate in the system. Understanding the complex problems situation that may be from different viewpoints of stakeholders was the principal factor of SSM (Liu et al. 2012).

SSM consists of a Seven-Stage Model, which is utilised to clarify an unstructured or fuzzy problem situation in order to generate the idea of human activity systems that would assist and adjust the situation (Checkland & Scholes, 1990). The SSM consists of a "Root Definition" that will be used as an explanation of a Human Activity System that what relevant systems have to do, and who involved with the systems (Mason & Willcocks, 1994). The stakeholders' viewpoints, summarised as **CATWOE** criteria, were used for analysing and formulating root definition of a problem situation as described in section 2.6.2.

One of the key points of SSM that is significant in comparison of the conceptual models with the problem situation so as to identify the change of desirable and feasible, then monitoring and controlling the development of a model system (Kinloch, 2008; Liu et al., 2012).

Effective Technical and Human Implementation of Computer-Based Systems (ETHICS)

Effective Technical and Human Implementation of Computer-based Systems (ETHICS), was developed by Enid Mumford (Mumford, 1993). The objectives of the ETHICS methodology was based on the concept of user participation needs as a significant feature in order to redesign process, improve and assist to create systems by discussion the existing problems and introducing new technology that is a necessary prerequisite in order to increase the

effectiveness of the existing organisation system service (Adman & Warren, 2000; Kinloch, 2008; Mumford, 1993, 2000).

The ETHICS method has been utilised in order to develop techniques within organisational systems and social system such as banks, and hospitals (Mumford, 2000). One of the key factors of the ETHICS philosophy is the participants' viewpoints, which play an important role in the development of systems and another significant aspect is concentrating on the job satisfaction needs (Hirschheim & Klein, 1994). In addtion, Kinloch (2008) stated that the key point of the Mumford's ETHICS system's design process is that it needs to encourage participation, improve working life quality of users, produce systems, which enhance job satisfaction of users and make the best systems for the users as suitbale tecnology to suitable people in the organisation (Hirschheim & Klein, 1994; Mumford, 1983).

The philosophy of ETHICS consists of six stages, which are used to implement an Information Technology (IT) solution to a problem situation. It was used to develop a new information system within organisation system (Kinloch, 2008). Mumford (2000) identified the six stages of ETHICS as follows: "Stage one: Diagnosis of Needs, Stage two: Setting of objectives, Stage three: identifying solutions, Stage four: Choice and Implementation of Solution, Stage five: Follow-up evaluation and Stage Six: preparing a detailed work design" (Hirschheim & Klein, 1994).

To summarise, ETHICS would not be chosen for the investigation of this research. It is mainly aimed to increase the effectiveness of the existing information technology service and aimed at successfully implementing computing and technology implementation related Information Technology (IT) solutions to problem situations. It would therefore be unsuitable for this research study.

Multiview

Multiview was developed in 1985 and has been continually refined to become an approach for developing Information Systems (IS). It was proposed as a Multiview model and offered as an explorative structure in order to develop information systems (Avison & Wood-Harper, 1986; Avison & Wood-Harper, 1990). The Multiview methodology includes both hard and soft aspects that are used for adapting to the particular situation in the organisation and the application in order to develop solutions to problem situations (Avison *et al.* 1998, Kinloch 2008). Avison and Wood-Harper (1986) identified that "Multiview is a pragmatic approach, and was developed by using action research methods". It is a useful proven tool that is used in a number of situations, can incorporate many aspects and the views of the many users who are involved in information system development (Avison and Wood-Harper 1986). The core functionality of Multiview is an enquiring model for Information Systems development that considered the needs of personal aspects (Users), and organisation and technical aspects (Computer Specialists or system analyst). One of the key potentials of Multiview is developing human computer interaction of IS development (Bickerton and Siddiqi 1993, Avison *et al.* 1998).

Multiview consists of five stages incorporating five different viewpoints that are used to consider the progressive development of an analysis and design project. The function of five stages is moved from the general to the specific that mainly aims to complete an increased understanding of the problem situation in both technical and human aspects in order to seek appropriate IS for using within organisation systems. Nevertheless, there are some limitations, Multiview model is not always suitable when developing new Information Systems (Avison et al., 1998; Kinloch, 2008).

The Five stages of Multiview are as follows:
Stage one: Analyse Human Activity Systems, Stage Two: Analyse Information, Stage Three: Analyse and Design socio-technical aspects, Stage Four: Design of Human-Computer Interface, and Stage Five: Design technical aspects (Avison et al., 1998).

The Multiview model is shown in Figure 2.9

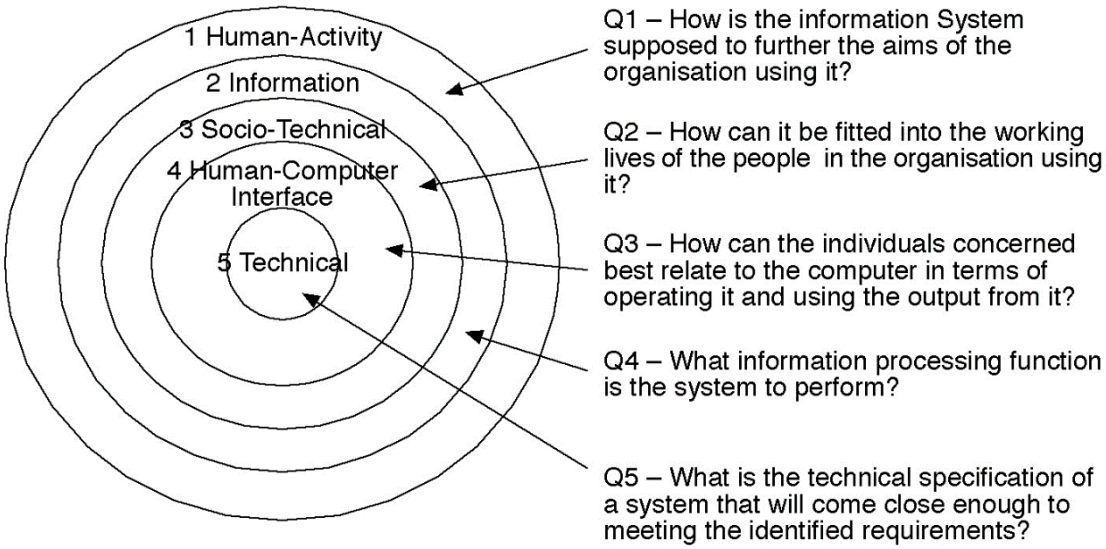

Figure 2.9 The Multiview Model (Avison et al., 1998)

In conclusion, Multiview Model would not be able to select for analysis of this research because the functionality of Multiview model is used in developing and designing Human-Computer Interaction (HCI). It was aimed at a successful implementation of technology and computing related solutions to problem situations. This is suitable for finding the solution of Information Technology when developing a new IT system in an organisation. For this research study, it can be concluded that Multiview is not appropriate for decision support model of MLT development.

Viable Systems Model (VSM)

The Viable Systems Model (VSM), created by Stafford Beer, is an organisation structure model that expresses for any viable system. The viable system is any system which encourages a way in which to arrange the demands to survive in the situation of environments changing in an organisation. The VSM expresses a model, which is used as a model in order to understand organisation structure, redesign, and support with the idea of complexity management (Espejo & Gill, 1997; Kinloch, 2008). The VSM is well known as the management cybernetics theory description models that are suitable for the complex system of organisation. It enables workers to solve organisation issues (Kinloch, 2008; Leonard, 2009). Additionally, Schwaninger and Scheef (2016)

identified that the VSM is a reliable regulation device for the exploration and organisation design to support their development potential.

One of the significant features of the VSM system is a powerful tool in helping an organisation's staff member to cope with a complexity of the system processes and adaptable organisation. In particular, assisting in designing a systematic view which is effective for their management. VSM can be described as a strategic plan for balancing the higher level systems (external perspective) emerging from the many people activities and lower level systems (internal perspective) of any one person involved in organisation in order to maintain control of essential activities (Espejo, 1990; Espejo & Gill, 1997; Kinloch, 2008).

The five functions of the Viable System Model that are used to operate effectively in a changing environment are (Espejo & Gill, 1997): (1) Implementation is used for producing units of the products or services., (2) Co-ordination is used to coordinate the producing units such as value-adding functions., (3) Control, the middle management, is used to define a resource negotiate., (4) Intelligence, this function is used to link between the viable system and the external environment in order to plan and design the future products or services. (5) Policy is used to control and provide clarity about the overall organisation's value.
The Viable System Model is shown in Figure 2.10

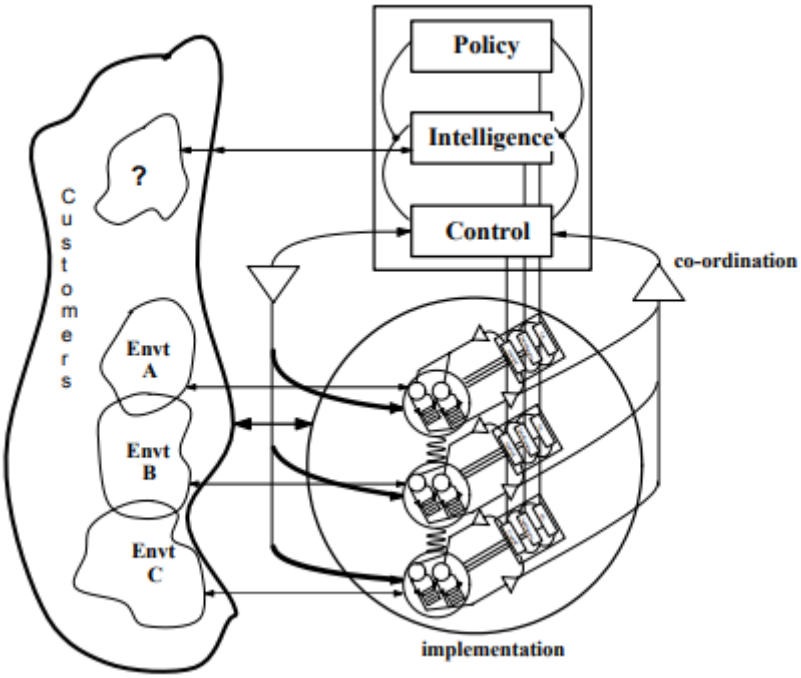

Figure 2.10 The Viable System Model (VSM) (Espejo & Gill, 1997)

To summarise, the Viable System Model (VSM) is effectively applied when the organisation has been changed or adapted such as the environment, organisation structure or organisation policy, which is not an aspect of this research study.

2.4.3 Discussion to select the Methodologies

It can be seen clearly that the socio-technical approach has been chosen for this research as Soft System Methodology (SSM) as its methodology complements the requirements of the development of a decision support model of mobile learning technology.

SSM technique used to described the complex problem situations in terms of requirements or objectives are not clear or difficult to find solutions. It allows analysis of different viewpoints and discusses several perspectives of personnel involved within the situation. SSM assists different users to understand unstructured or messy problem situations of each other's perspectives and requirements (Kinloch, 2008).

In addition, Fuchs (2004) stated that allowing people who are involved with the problem situations to participate with developing the system, would enable

them to assist and fulfill users' requirements. It helps people who participate in the system process to find out the solution to their complex problem situations and learn regarding methods to improve the system effectively. Therefore, the SSM is the best suited for this research in terms of being able to deliver the appropriate solution. It makes unstructured problem situations clearer by using a Root Definition in order to describe Human Activity System, to explain what the system is, and using CATWOE to explain each element of the systems. A seven-stage process of SSM will assist improving and translating the requirements through designing a decision support model. Furthermore, the decision support model will be compared with the real world in order to examine desirable and feasible change.

The SSM has a complete capability and is an effective tool for handing the unstructured problems. It helps in developing an understanding of complex problem situations through providing and designing a structure in order to assist in the analysis. Accordingly, Soft System Methodology is an appropriate methodology for this research, which not only considers technical viewpoints but also the social viewpoints, for developing the decision support model of Mobile Learning Technology (Kinloch, 2008).

The following section presents the concepts of Soft System Methodology (SSM) that will be used for this research.

2.5 Soft Systems Approaches

Checkland and Scholes (1990) stated that 'hard' systems thinking is appropriate in well-defined technical problems and that 'soft' systems thinking is more appropriate in fuzzy ill-defined situations involving human beings and cultural considerations". In general, hard systems are scientific approaches to objective and clearly defined problems that have one correct solution, while soft systems are social approaches, subjective and complex or poorly defined, and involve human activity, social, and cultural components.

2.5.1 Soft Systems Methodology (SSM)

Soft Systems Methodology (SSM) focuses on creating human activity systems and human relationships needed for an organisation or group to achieve a common purpose. It is a system–based methodology and action research approach to solving 'messy' or 'fuzzy' or 'complex' unstructured real world problem situations that also provides an overall model for root causes (Checkland, 2000; Tajino & Smith, 2005). SSM was used in various organisations in order to establish organisational requirements for achieving a common purpose and bring about an improvement of social concern by stimulating people who were involved in the situation (Checkland & Scholes, 1990). Lewis (1993) claimed that SSM had been used extensively as a means of conducting complex problematic situations. Regarding learning systems, SSM can be used to organise the problematic, which is an unclear problem or solution (Checkland, 1981). The aim of SSM is to enable the stakeholders' viewpoints relating the system to be taken into account (stakeholders means people who are involved with the organisation system) (Por, 2008). Various researchers used SSM in many case studies; for example, Mingers and Taylor (1992) studied the use of SSM in practice and found that generally, most people perceived that using SSM was satisfactory and successful. Taylor et al (2007) investigated the benefits of SSM for the development of computer game designs. In the field of health care, soft systems methodology was found to assist in planning strategies (Lehaney & Paul, 1994), and Por (2008) stated that SSM was suitable for service-focused studies in researching nursing education. Islam (2013) used SSM as a model of the perceptions of Educational

Psychologists' views and found that it is useful in developing a model for EP services. It appears that using SSM can increase the chance of understanding and choosing the best possible ways for solving the problem of a social situation. Additionally, it can be helpful in understanding the problem and situation (Schmidt, 2006). In this research, developing the education system in Thailand which provides education technology (m-learning), has numerous factors including human activity and social such as interest, retention, and perception, where stakeholders perceive problems differently, so Soft Systems Methodology is the best way to approach a model of the effectiveness of m-learning on pedagogy.

This research study will use Checkland's Methodology (Soft Systems Methodology) as a research approach to provide conceptual models for deriving an overall model of the root causes of the mobile learning system problems.

2.5.2 Soft System Methodology Process

The SSM consists of Seven-Stages Model (Checkland, 1981) as shown in Figure 2.11

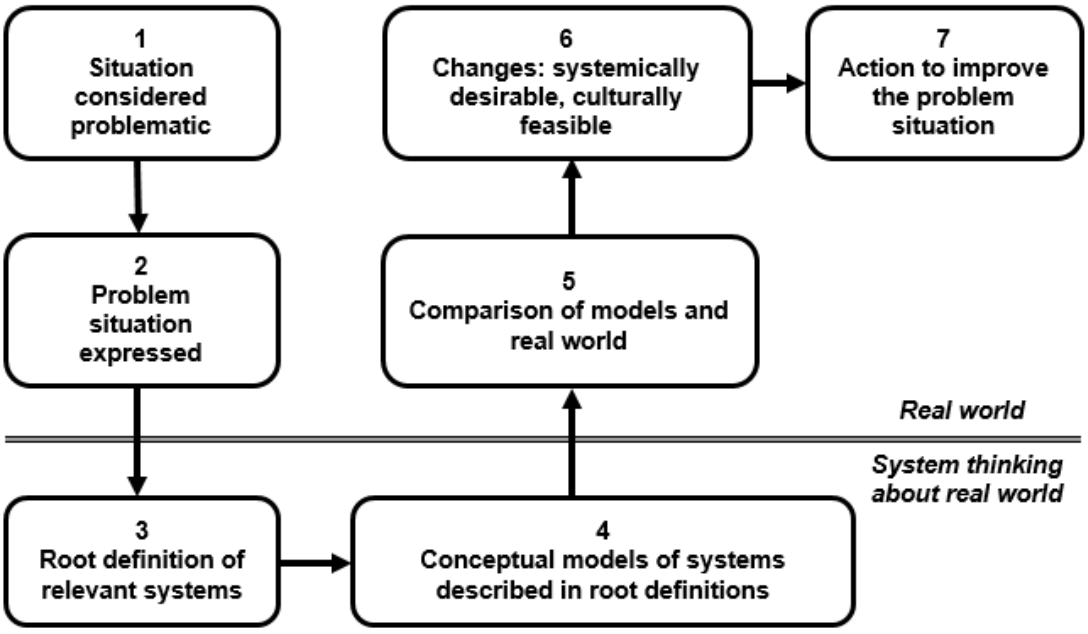

Figure 2.11 The seven-stages model of SSM (Adapted from Checkland, 1981)

Figure 2.11 showed the seven stages of SSM as described by Checkland and Scholes (1990), it has divided into two main categories: (1) it is used to address

the real world (physical aspects) and (2) it is used to address the system thinking about the real world (conceptual aspects). The seven-stage model of SSM is explained as follows.

Stage 1: Investigate and consider the unstructured problem situation.

Stage 2: Problem Situation Expressed. Stage one and stage two are conducted to discover the problem situation in order to explore the problem and then summarise through the “Rich Picture" that Checkland and Poulter (2006) have stated aims to “capture informally, the main entities, structures and viewpoints in the situation, the processes going on, the current recognised issues and potential ones.” It shows a complex situation through picture form

Stage 3: Root definitions will be used to provide an explanation for the situation of what relevant systems have to do, and who is to do the systems (Mason & Willcocks, 1994). In this stage, root definitions are used to explain what the systems is doing and CATWOE has been used analyse those involved with the system. CATWOE details are as follows:

C: Customers who are victims or beneficiaries.

A: Actor who is concerned in the situation.

T: Transformative process the conversion of input to output.

W: Weltanschauung the worldview that makes a big picture.

O: Owner who owns the process or situation of the transformation.

E: Environment Constraints elements outside the system.

Stage 4: Conceptual models providing an understanding of change activities. The conceptual model systems will monitor and control the effectiveness, efficacy and efficiency (Por, 2008). It is developing conceptual models based on the relevant root definitions.

Stage five to stage seven expose the process back to the real world.

Stage 5: Comparison between conceptual models that have been developed and the reality of the real world situation, using the models to arrange situation questioning and inquiries to determine changes that might improve the situation.

Stage 6: The criteria changed to identify possible changes are desirables in principle and feasible to implement. This stage is concerned with the suggestions for seeking the purpose and desired condition.

Stage 7: Take action to improve the problem situation.

2.5.3 Discussion

SSM is a methodology used for solving complicated and unstructured problems. It appears that SSM is appropriate to be used for solving complex problems or it can be used to support a variety of existing opinions. SSM can increase the chance of understanding the complex problem(s) in a social situation and lead to viable solutions. SSM can providing a conceptual model, which is significant to a group of people who are involved with the system. Therefore, in this research SSM will be used as the process to develop a conceptual model guide for using mobile learning technology. It can be concluded that, the process uses the Soft System Methodology (SSM), which is a well-proven tool for investigating an unstructured problem such as the one considered in this research.

Overall, Soft System Methodology technique has been used for facilitating an in-depth discussion of teachers' perspectives and school managers' perspectives. In addition to this, SSM has been used to understand the different viewpoints of participants. Each stage of SSM facilitated the discussion from stage one to stage seven effectively, including the creation of Rich Picture, Root definition, and CATWOE analysis that helped the researcher focus on participants' issues and helped to develop the conceptual model. This can be noted that the use of SSM is a significant strength for using in this research, in terms of facilitating discussion and can capture the in-depth perspectives of the group of participants and their individual viewpoints.

Finally, the use of soft system methodology to extract teachers' perceptions and school managers' perceptions of mobile learning technology usage in primary school as utilised in this research, is a novelty because this SSM has not been used with MLT in order to approach the model prior to this research. Additionally, SSM can be used to promote in-depth discussions among both teachers and school managers. Furthermore, the SSM was used to approach the model, which could be used to duplicate in future studies with a similar context.

2.6 Summary

This chapter presented the literature review. It provided a background, definition of mobile learning and discussed with traditional learning through an evolution of existing mobile learning technology model. It also presented the technological approaches and Soft System approaches. The next chapter will present the methodology used in this research.

Chapter 3 Methodology

Introduction to Chapter

This chapter discusses the methods used to explore and analyse the use of mobile learning technology in primary schools for teaching, and then develops a suitable decision support model of mobile learning technology model. The chapter discusses the methods that were used to collect and analyse the different data used for this research.

This chapter begins by presenting the methods used for this research, followed by the processes of research design, and participants which are used in this research. Quantitative data collected via questionnaires is used to examine the requirements for Mobile Learning Technology used in primary schools and qualitative data collected via semi-structured interviews is used in order to seek an in-depth understanding of individual participants' perspectives.

3.1 The methodology used for this research

The methodology adopted for the research reported in this study was based on Soft System Methodology (as mentioned in the research design section). In addition, the method for data collection and data analysis of this research is based on mixed methods as described below.

3.1.1 Mixed-Methods research

A mixed-methods research methodology involves both quantitative and qualitative approaches within a single research study (Morse, 2003). Johnson et al. (2007) stated that the mixed methodology research is "the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration". Mixed methods concerns both quantitative and qualitative aspects of research (Teddlie & Tashakkori, 2003).

Quantitative methods focus on theoretical tests and summarising broadly general results (Corbetta, 2003). The data used for the research concerned frequencies or rates, and was analysed by various statistical techniques (Payne & Payne, 2006, p.180). Generally, quantitative techniques consist of questionnaires surveys, and observation techniques (Malhotra & Birks, 2003). For example, questionnaires for investigating customer satisfaction, market research questionnaires (product survey), and questionnaires exploring requirements for learning support, etc.

Qualitative methods were used to collect data, which concentrated on the specific details of the situation (Corbetta, 2003). These methods can help to analyse individuals' behaviours and provide understanding, which is deeper, and more penetrating (Malhotra & Birks, 2003). In general, qualitative techniques include formal and informal interviews such as semi-structured interviews, observation, and focus groups (Malhotra & Birks, 2003; Morse, 2003).

Overall, it can be seen that quantitative methods and qualitative methods can be used together in a complementary manner in order to increase the thoroughness of this research study. These can provide the perspectives of participants from broad understanding to in-depth understanding. The mixed-method approach can provide strong findings for the research about which Creswell et al. (2003) stated that an integration of the quantitative and qualitative methods can access understanding of the participants to be better and broader.

Consequently, this research has used mixed-methods to explore the effectiveness of the use of mobile learning technology for teaching focused on primary education in Thailand.

As mentioned earlier, this research began with employing the quantitative methodology as questionnaires method followed by the qualitative methodology as semi-structured interviews method in order to approach the deepest perspectives. The primary method of data collection was a questionnaire, used to obtain the views and the methods of mobile learning technology for teaching and for delivering primary education via mobile

technology. The second data collection method was semi-structured interviews. The semi - structured interviews have been used to gather and analyse data from educators and school managers in order to provide a deep understanding of curriculum needs in primary school education. Therefore, semi-structured interviews can assist to develop, a model of methods based on mobile technologies for teaching, and then test the curriculum delivery model on the effectiveness of the improved primary education system.

In conclusion, this research study will use mixed-methods in order to approach the finding results. The research study begins with a literature review. The purposes of the use of mixed method are used to collect the knowledge and consider several viewpoints from participants.

3.2 Research Design

The present research aims to develop a decision support model of mobile learning technology in order to employed within a primary school. Therefore, this section shows the research design of this thesis, which guides the reseach data collection, and is based on Soft System Methodology.

Soft System Methodology (SSM)

Soft System Methodology that was reviewed in the previous chapter has been used to consider participants' viewpoints focused on explaining messy or complex problem situations, which is a situation is having difficulty to make a decision and hard to find a solution. In addition, SSM was used for investigating the perceptions of teachers and school managers through the findings of this research. This research will use SSM to provide a conceptual model as a decision support model in order to derive an overall model for solving problems in mobile learning technology. Therefore, SSM will be used to examine the model for the use of mobile learning technology for teaching.
The researcher has set the research designs for conducting the research in seven steps as well as the operation method as shown in Figure 3.1

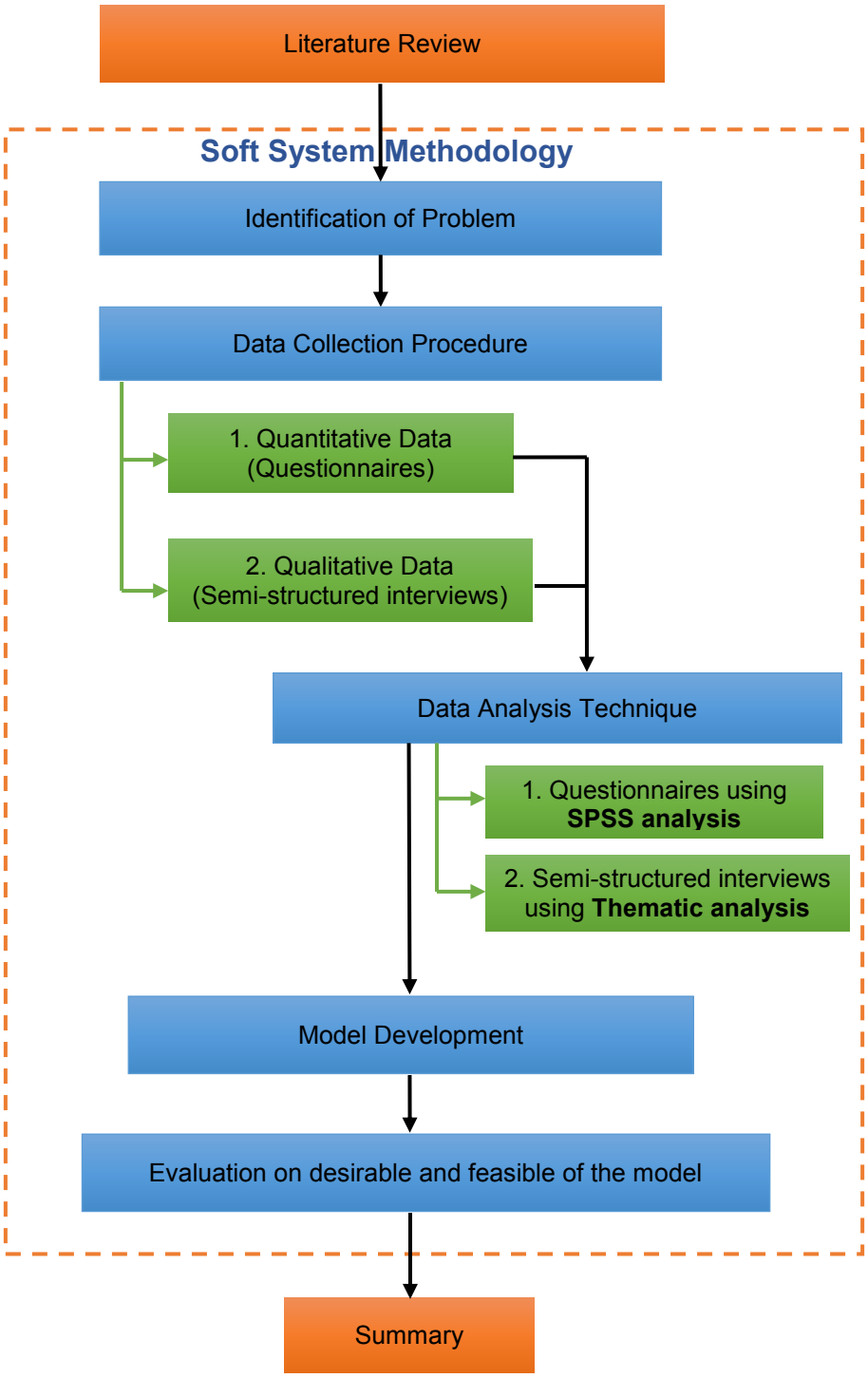

Figure 3.1 The stages of research design

This section present the methodology of this research based on (SSM) techniques: (1) Literature review, (2) Identification of problem, (3) Data Collection, (4) Data analysis, (5) Soft System Methodology application (6) Model Development, and (7) Evaluation.

3.2.1 Literature Review

Throughout this research, there will be a critical review of the literature on technology-enhanced teaching in developing countries, particularly Thailand and its surrounding areas. In the mobile technology review, by using old references back from the 1990s, it can understand how evolution changed the use of mobile technology in education.

3.2.2 Identification of Problem

This step will analyse the teaching methods and techniques used by teachers for making use of existing mobile technology in the classroom contexts in order to determine appropriate technology usage mechanism in a classroom environment.

The method used in this section is a questionnaire, to acquire the requirement of teachers when using mobile learning technology.

3.2.3 Data Collection Procedure

Thailand is divided into four regions namely Central, North, Northeast, and South. In this research, the researcher selected a sample of local primary schools in the North of Thailand. The report of the office of the Thailand National Economic and Social Development Board (2015) revealed that the Human Achievement Index (HAI) of the whole country of Thailand found that the north of the country has made the most progress in the development of housing and environments but made the least progress in terms of education. In addition, the percentage of uneducated populations in 2013, compiled by the same report, showed that amongst the four regions of Thailand, the north has the most uneducated people, with 926,482 people (9.1%); the south has 397,781 people (5.3%); the northeast has 409,942 people (2.2%), and the central region has 797,539 people (8%). In accordance with the Office of the Permanent Secretary, the Ministry of Education (2013) points out that the elementary school level is a compulsory education and “elementary education puts

emphasis on basic literacy and numeracy skills and cultivates desirable behaviour in students". Statistical analysis of pupil performance across Thailand indicated that the northern area was most in need of improvement. As mentioned above, this research focuses on the northern area of Thailand. The Government of Thailand has realised that northern areas could benefit the most from improvements to the quality of education.

The methodology used within this research is a mixed-method of data collection. Questionnaires and semi-structured interviews were used as a method for collecting data that could be useful for this research. Therefore, the data collection methods have divided into two sections as follows:

3.2.3.1 Data Collection of Quantitative through Questionnaires

The data was collected by online questionnaire and paper-based questionnaire, which was handed out to the school managers and teachers by the researcher. In order to test and evaluate the effectiveness, efficacy and, efficiency of the experimental mobile learning technology model, the data was collected using a paper-based questionnaire for evaluation on the desirability and feasibility of the decision support model of mobile learning technology.

3.2.3.2 Data Collection of Qualitative through Semi-structured interviews

The data was obtained via face-to-face and audio recording of semi-structured interviews to gain an in-depth understanding and requirements of individual participants of mobile learning technology usage. Teachers and school managers conducted the interviews honestly to share their experience, opinions, knowledge, and perceptions of the use of mobile learning technology for special requirements.

3.2.4 Data Analysis Techniques

This research study has used questionnaire and semi-structured interview techniques. Therefore, the data analysis of questionnaire and semi-structured interview has been divided into two sections:

3.2.4.1 Data Analysis of Questionnaire

The questionnaire technique has been used to collect data about the methods of mobile learning technology for the teaching of educators in the primary school education curriculum in order to understand teaching methods of mobile learning technologies. In addition, the questionnaire will be used for evaluation of the design of the decision support model of MLT in order to identify methods for teaching and to identify the success or failure of the model in primary school education establishments.

The data results of study of the Requirements of Mobile Learning Technology and the findings of the data evaluation on desirability and feasibility of the decision support model will be analysed by using Statistical Package for the Social Science for Windows (SPSS) to interpret a result of a quantitative questionnaire.

This analysis consists of descriptive analysis to show the arithmetic average as well as the percentage average of the methods of mobile learning technology.

3.2.4.2 Data Analysis of Semi-structured interviews

Semi-structured interviews have been useful to collect data amongst teachers and school managers of educational services about mobile learning technology.

The qualitative technique through semi-structured interviews was used to collect data amongst teachers and school managers of primary school education about mobile learning technology. The interviews were recorded and transcribed later (see consent form in Appendix G). The data analysed and the findings presented by thematic analysis in order to group the participants' opinions and attitudes toward the use of mobile learning technology at primary school in order to provide an in-depth understanding of individual participants of the topic. The group of respondents were teachers and school managers, divided into two groups from urban and rural areas.

The method of data analysis of the semi-structured interview transcripts was thematic analysis. Themes were identified from the perspectives of teachers who had taught with MLT, and school managers who had developed and delivered the curriculum with MLT in primary schools. First, the voices were recorded and then transcribed. Second, we set coding of data with the initial codes to group the data. After that, themes and sub-themes were generated.

The data obtained from the questionnaire and semi-structured interviews on mobile learning technologies will be used to design a mobile pedagogical model for adoption of mobile technologies in learning and in the delivery of primary education.

3.2.5 Soft System Methodology

Soft System Methodology (SSM) was selected to solve problems that participants encountered. It was used to provide a decision supp model of the effectiveness of mobile learning technology for teaching and for delivering the curriculum in primary school education. The SSM focused on simplifying the discussion and investigating the individuals' perception within the primary education system.

SSM aims to solve complex situations, such as where teachers or school managers are having difficulty to make a decision and it hard to find a solution by lacking clarity about purposes, conflict, indecision about the environment (Jackson, 2003). SSM solve the complex situations by approaching the problems of the education system in the use of MLT in primary school teaching and delivering a curriculum (Checkland, 1981; Checkland & Scholes, 1999). SSM can be used to guide the researcher in terms of working collaboratively with individuals within the primary school education system in order to develop both insight and in-depth understanding of the problem of using MLT for teaching (Islam, 2013).

The outline of SSM consists of the four key stages of activities that the methodology is employed to approach and explore the problem situations within a particular primary school education system in the use of mobile learning technology (Checkland & Scholes, 1990)

The four main stages of SSM as described by Checkland & Scholes (1990) are as follows: (1) Finding out is exploring and analysing the problem situation, (2) Model generating is proposing the activities as conceptual model that related to the situation, (3) A discussion is used to investigate the desirability and feasibility of the model, and (4) Taking action is taking action to improve the problem situation (Checkland & Poulter, 2006).

This present research study employs the seven-stages model of SSM as mentioned in section 2.5.2 of chapter 2 because this model clearly explains both process and activities of each stage. Therefore, the seven-stages of SSM will be employed to facilitate finding the problem situations and then creating conceptual models to improve activities practice.

3.2.6 Model Development

The development of a decision support model of mobile learning technology is developed base on the literature review and data analysis from semi-structured interviews and questionnaires related to the requirement and attitude of the use mobile technologies for teaching primary education curriculum.

3.2.7 Evaluation

The decision support model of this research developed in order to aid teachers in approaching different teaching methods within mobile learning in the classroom. The features that are relevant to mobile learning environments have been identified. At the end of the development model, a sample of participants who participated in semi-structured interviews is used to evaluate the desirable and feasible aspects of the model. The effectiveness of the decision support model of mobile learning systems in a real-world environment via fieldwork in elementary schools has been completed by using a questionnaire to evaluate the desirable and feasible decision support model of mobile learning technology. In order to analyse the evaluation questionnaire, a rating scale was used to collect data, and SPSS was used for analysing data.

3.3 Participants

There are 385 schools in the Phitsanulok area of Northern Thailand, a random sample of 193 of these schools from urban and rural areas is selected for quantitative research via a questionnaire. In urban areas, the questionnaire is distributed online (Online Questionnaire), and in rural areas due to lack of online resources, a paper based questionnaire is used and handed out to the school managers and teachers by the researcher. The online questionnaire is in exactly the same format as the paper based questionnaire in order to avoid any bias in the mode of administration.

Qualitative research is conducted via face-to-face semi-structured interviews after the pilot study. A purposive sampling approach is used to select participants based on the Human Achievement Index (HAI, 2015). An appropriate sample size of between 15 and 20 schools is selected (Bertaux, 1981) that covered elementary school sectors in the Phitsanulok area of northern Thailand.

Additionally, 15 schools are selected and are invited to semi-structured interviews. The group of respondents for semi-structured interviews consisted of school managers and teachers. It is important that all teachers and school managers who are selected to participate in this research were familiar with the use of mobile learning technology.

3.3.1 Participants of Questionnaires

There were 398 participants experienced in the use of mobile learning technology (teachers and administrators of schools). There are 322 participants of the paper questionnaire and 76 participants of the online questionnaires, from primary schools in Thailand participating in this study.

Regarding evaluating the desirability and feasibility of mobile learning technologies, the sample group of participants who participated in semi-structured interviews are invited to complete an evaluation questionnaire (this included 17 teachers and 10 school managers).

3.3.2 Participants of Semi-structured interviews

Teachers and school managers belonging to the 15 primary schools from various parts of Phitsanulok Province (both urban areas and rural areas) participated in the qualitative data collection. The group of respondents, consisting of 17 teachers who had used mobile learning in their teaching and 10 school managers who were involved in planning the mobile learning curriculum, were invited to semi-structured interviews.

3.4 Summary

This chapter described details of the research methodology that was used to approach and conduct in this research. In addition, the selection methods used for the analysis of the findings have been discussed. The research process is summarised as shown in Table 3.1

Table 3.1 Research Methodology

Research Process	Study Resources	Sample size and Research Tools	Results
Literature Review	**Secondary Data** - Related research - Documents, Books or media		- Principles and theories in research development.
Identification of Problem	**Secondary Data** - Related research - Documents, Books or media		
	Primary Data - The findings of questionnaires in analysing the teaching methods and techniques of the use of mobile learning technology in the classroom	**Sample Group** - A group of 193 primary schools are in the Phitsanulok area using mobile learning technology 335 teachers and 63 school managers were asked. - Online and Paper- based questionnaire for the requirements of mobile learning technology	- The concept of model design - The requirements of Mobile Learning Technology of teachers and school managers

Table 3.1 Research Methodology (Cont.)

Research Process	Study Resources	Sample size and Research Tools	Results
Data Collection Procedure	**Primary Data** - Questionnaires (online and paper- based) - Semi-structured Interviews (face-to-face) **Secondary Data** - Related research - Documents, Books or medias		
Data Analysis Technique	**Primary Data** - Questionnaires - Semi-structured Interviews	**- SPSS** (Descriptive analysis) **- Thematic analysis**	
Soft System Methodology	**Primary Data** - The results of Semi-structured Interviews **Secondary Data** - Related research - Documents, Books or medias	**Sample** - From a group of 15 primary schools using mobile learning technology 17 teachers and 10 school managers were interviewed - List of Semi-structured interviews for teachers' perspective and school managers' perspective	- The development of decision support model of mobile learning technology

Table 3.1 Research Methodology (Cont.)

Research Process	Study Resources	Sample size and Research Tools	Results
Model Development	**Primary Data** - The results of questionnaire and semi-structured interviews	**Sample** - 335 teachers and 63 school managers - SPSS (Descriptive analysis) - 17 teachers and 10 school managers - Thematic analysis of semi-structured interviews **- Seven stages of Soft System Methodology**	**- A Decision Support Model of Mobile Learning Technology**
Evaluation	**Primary Data** - The results from Evaluation Questionnaire	**Sample** - 17 teachers and 10 school managers who participated in semi-structured interviews. - Questionnaire on the evaluation of desirable and feasible aspects of decision support model of mobile learning technology. - Decision support model of Mobile learning technology.	- The results evaluation of desirable and feasible aspects

Table 3.1 Research Methodology (Cont.)

Research Process	Study Resources	Sample size and Research Tools	Results
Research finding, Discussion and thesis writing	**Primary Data** - Research Results **Secondary Data** - Documents, books		- Research conclusions and suggestions - Thesis report

In chapter Four, the findings of questionnaires (pilot study) in the form of descriptive analysis and the findings of semi-structured interviews in the form of thematic analysis will be presented and discussed.

Chapter 4 Results

Introduction to Chapter

This chapter provides the findings of the research study. The chapter begins with the results separated into two sections. First, quantitative data via questionnaire related to the Requirements of Mobile Learning Technology are presented in descriptive statistics. Second, the findings of semi-structured interviews relating to the opinions and attitudes towards using Mobile Learning Technology in primary school are presented. The results of qualitative analysis also are reported through seven stages of the use of Soft System Methodology techniques (SSM).

The findings of a Questionnaire for the requirements of Mobile Learning Technology

4.1 Data Analysis of Quantitative study (Questionnaire)

The data in this section presents quantitative data collected through a questionnaire. Statistical tests and cross tabulations were used to present descriptive statistics results.

The methods of this study collected and analysed in the Table 4.1 below.

Table 4.1 The Study Analysis Process

Data Type	Data collection	Data analysis
Quantitative Data	- Online questionnaire - Paper based questionnaire	- Descriptive statistics - Correlation statistics (Cross tabulations)

4.1.1 Data Collection

In urban areas a questionnaire was distributed online (Online Questionnaire), and in rural areas due to lack of online resources, paper based questionnaires were used to collect data from participants.

4.1.2 Data Analysis

In this section, the data from study of the Requirements of Mobile Learning Technology was analysed by the Statistical Package for the Social Science for Windows (SPSS). The study will examine the relationships or correlations of variables appropriate for analysis of data. The study results are shown in descriptive statistics, tables and graphs as follows.

From the 322 participants of the paper questionnaire and 76 participants of the online questionnaires, all 398 responses are educators and administrators of schools in Thailand (Phitsanulok Province). In the participating schools via the paper questionnaire, there are 83.9% teachers and 16.1% school managers. When asked about the school location, urban areas comprised 51.9% and 48.1% were rural areas, whilst for the online questionnaire (Appendix D) 85.5% are teachers and 14.5% are school managers. Regarding the school location, 27.6% being urban and rural areas 72.4%. Table 4.2 and Table 4.3 below outline “the positions of participants and the location of schools” used in this study.

Table 4.2 Position of Participants

Position	Frequency	Percent
Administrator of school	52	16.1
Teacher	270	83.9
Total	322	100.0

Table 4.3 Location of School

School Location	Frequency	Percent
Urban	167	51.9
Rural	155	48.1
Total	322	100.0

Table 4.4 Results of Using Cross Tabulation between Location of School and Experience in Using Mobile Technology in Education

		Do you have any experience in using mobile technology in education?		
		Yes	**No**	**Total**
Location of school	Urban	113(67.66%)	54(32.34%)	167(100%)
	Rural	92(59.35%)	63(40.65%)	155(100%)
Total		205	117	322

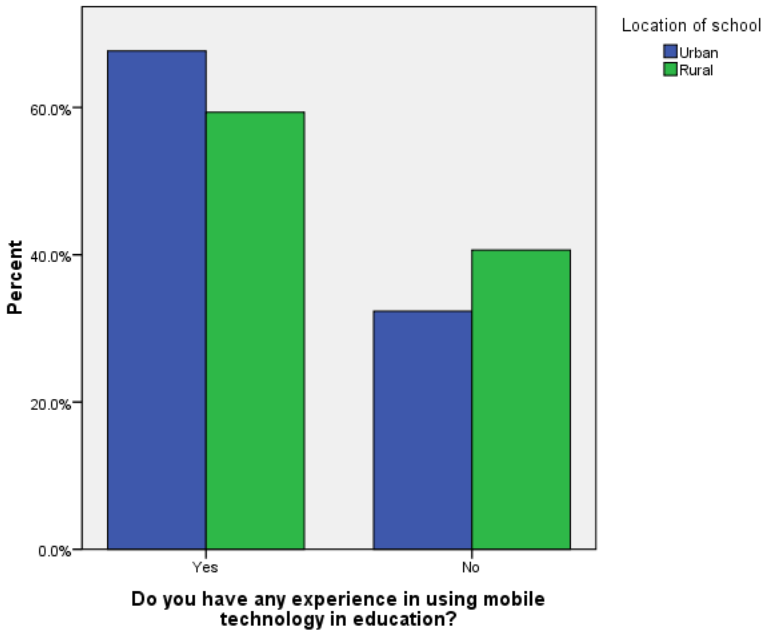

Figure 4.1 The Total Percentage of Participants who had Experience in Using Mobile Technology in Education comparison with Location of School

The results illustrated in Figure 4.1 and Table 4.4 above show data via paper based questionnaire when using cross tabulation between location of school and experience of participants in using mobile technology in education. A total of 322 participants shows that there are 113 (67.66%) respondents in urban who have experience in using mobile technology in teaching and 54 (32.34%) respondents who have no experience. Whilst in rural areas, there are 92

(59.35%) respondents have experience in using mobile technology in teaching and there are 63 (40.65%) respondents, have no experience. It can be seen that a higher proportion have experience in using mobile technology in education when compared with having no experience at 205 (63.66%) and 117 (36.34%) respectively. While the online questionnaire (76 respondents) gives different results, which were that 56.6% have no experience and 43.4% have experience in using mobile technology.

From previous data, Table 4.5 below shows the reason why teachers lack experience in using mobile technology in education. There were 117 (36.3%) teachers answering this question. Most participants' answers have indicated that they lack guidance and training (47%), and the school was not ready for mobile technology (43.6%), while the online questionnaire (76 respondents) shows different results. The online questionnaire has indicated that 38% of schools appeared to be not ready for using a mobile technology, and 36% of schools' report lack guidance and training in using mobile learning technology in their teaching (Appendix D).

Table 4.5 The Reason for Lacking of the Use of Mobile Technology in Education

Factors	Frequency	Percent
Lack of guidance and training	55	47.0
Remote distance	7	6.0
Lack of support from leadership	3	2.6
School not ready for mobile technology	51	43.6
Others	1	0.9
Total	**117**	**36.3**
Missing (9)	205	63.7
Total	322	100.0

Table 4.6 Which academic Subjects Do You Use Mobile Technology for Teaching

Academic Subjects	Frequency	Percent
Mathematics	67	32.7
English Language	52	25.4
Sciences	43	21.0
Others	43	21.0
Total	**205**	**100.0**
Missing (9)	117	36.3
Total	322	100.0

The next question aimed to show what academic subjects and which features/applications are used in mobile learning technology in teaching (Appendix A, question 2.3). The results illustrated in Table 4.6 above indicate that the main academic subjects using mobile learning technology are Mathematics with 32.7%, English language with 25.4% (with 21.0% using m-learning technology in Sciences and others subjects). Other subjects included Thai Language, Social Studies, Computer and Information Technology. In the online questionnaire, 76 responses show different results. Most subjects that use m-learning technology are other subjects with 43.9% such as Computer Technology and Thai Language. Approximately 34.1% of using m-learning technology is English language and 31.7%, 29.3% is Mathematics and Sciences respectively (Appendix D).

For question 2.3 and 2.4 (see Appendix A) when using cross tabulation (which shows table data analysis in Appendix C) was analysed in order to know which features/applications of mobile learning technology most selected for use in three academic subjects. According to, Figure 4.2 below, from the paper questionnaire, the majority of the educators' responses show that the features/applications used most are pictures with 60.68%, review/practice with 41.5%, and animation with 40.78%, quiz and games with 38.35%, 36.89% respectively. Whereas the online questionnaire shows different results most features/applications used are video 63.2%, quiz 56.6%, picture 48.7%, multimedia and animation with 46.1% and review/practice and games with 39.5%. Even though there are different results between the paper and the

online questionnaire, the similar features/applications that teachers mostly used are pictures, review/practice, games, quiz, and animation.

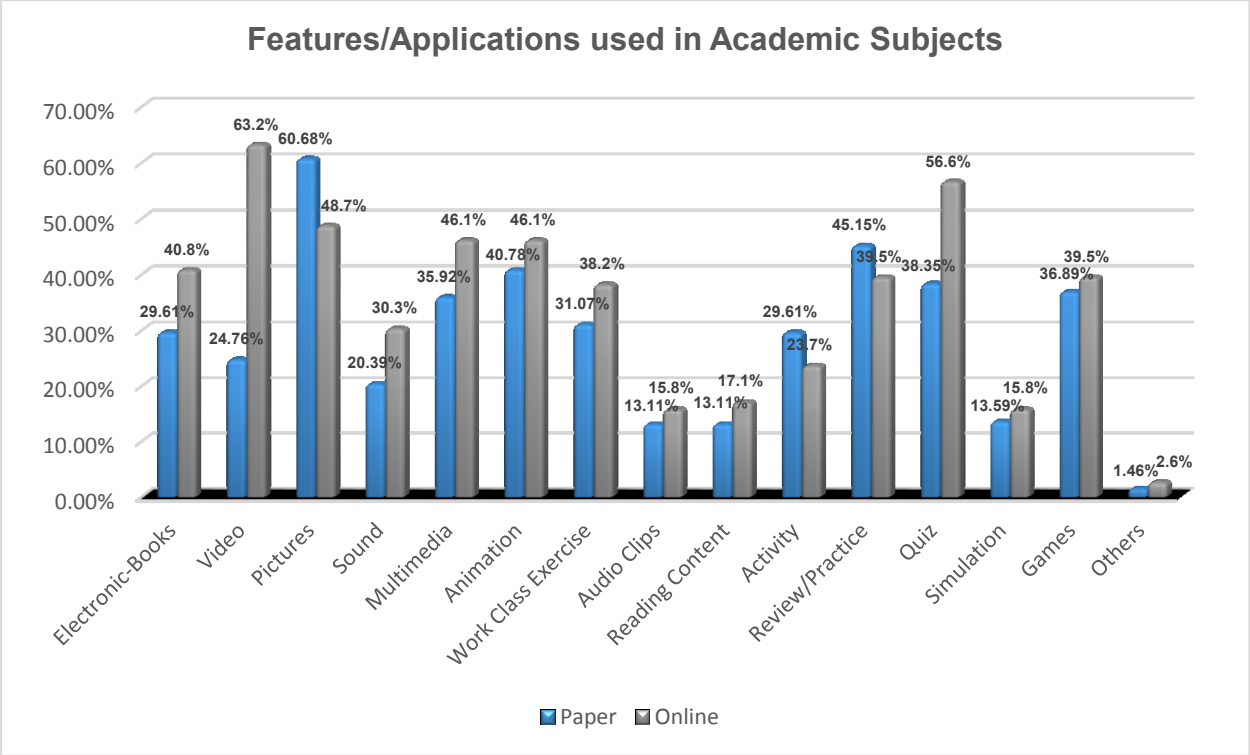

Figure 4.2 Features/Applications Used in Academic Subjects

Table 4.7 Mobile Technology is Useful for Teaching

Mobile technology is useful	Frequency	Percent
Yes	295	91.6
No	27	8.4
Total	322	100.0

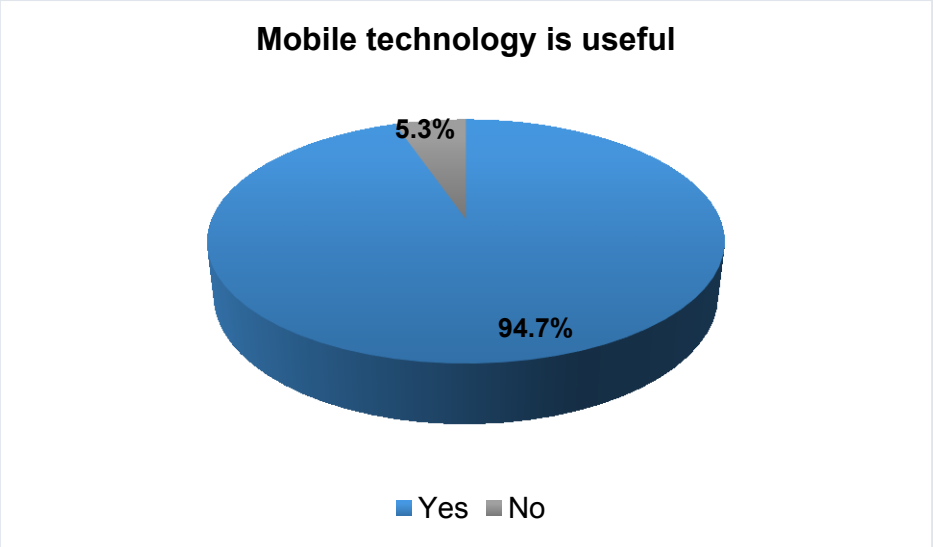

Figure 4.3 Mobile Learning Technology is Useful for Teaching (Online results)

Table 4.7 the paper questionnaire indicates that mobile learning technology is useful for teaching. The outcome shows a total of 91.6% answer "Yes" while 8.4% answer "No" which the outcome is similar through online questionnaire (Figure 4.3). The results illustrated in Figure 4.4 indicate that the first three most selected answers as to why mobile learning technology is useful for teaching are:

- Mobile Learning Technologies can improve pupils' enthusiasm with 65.20%
- Mobile Learning Technologies can improve the effectiveness of teaching with 52.20%
- Mobile Learning Technologies can motivate students to study with 44.10%

The online questionnaire shows that Mobile Learning Technologies can improve pupils' enthusiasm with 65.80%. Mobile Learning Technologies can

help make teaching more attractive with 50.7%, Mobile Learning Technologies can motivate students to study and can improve the effectiveness of teaching with 49.30%. Moreover, the results indicate why the teachers think Mobile Learning Technology is not useful for teaching. Illustrate in Figure 4.5 shows that the first three most selected answers are inappropriate environment with 6.50%, mobile learning technologies may contribute to distraction in classroom with 4.70% and curriculum is not supported with 4.00%; the online questionnaire results are similar to the paper based in the same sequence.

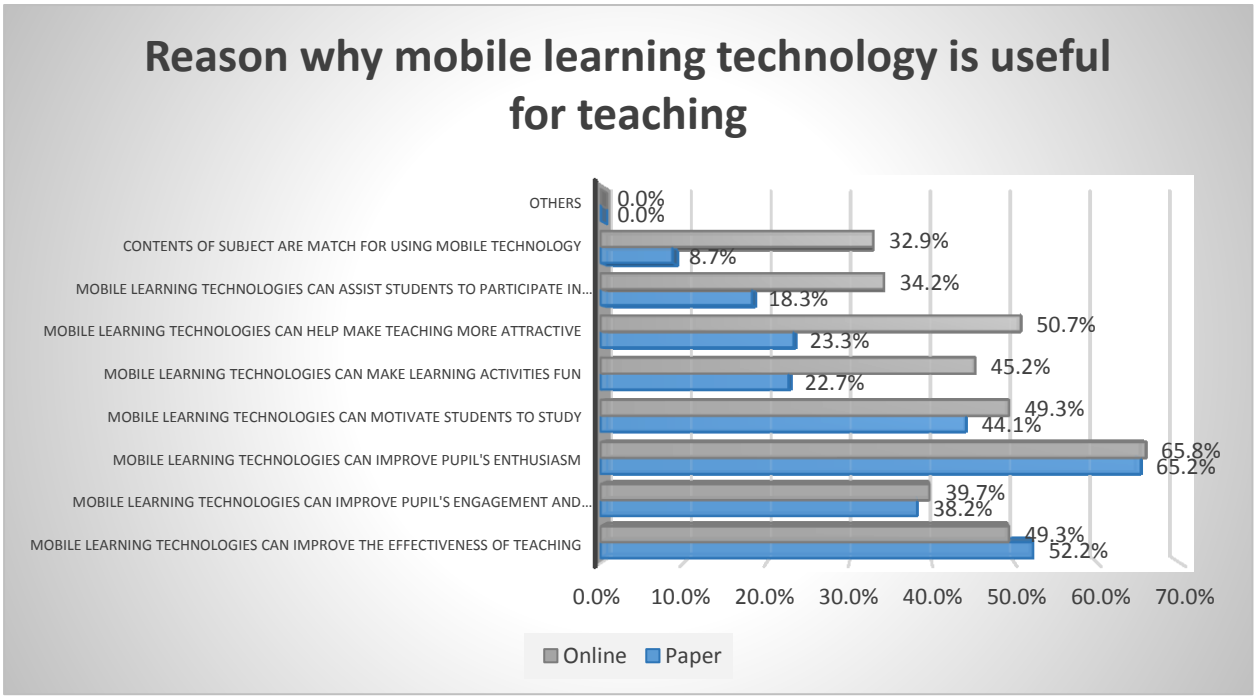

Figure 4.4 Why Mobile Learning Technology is Useful for Teaching?

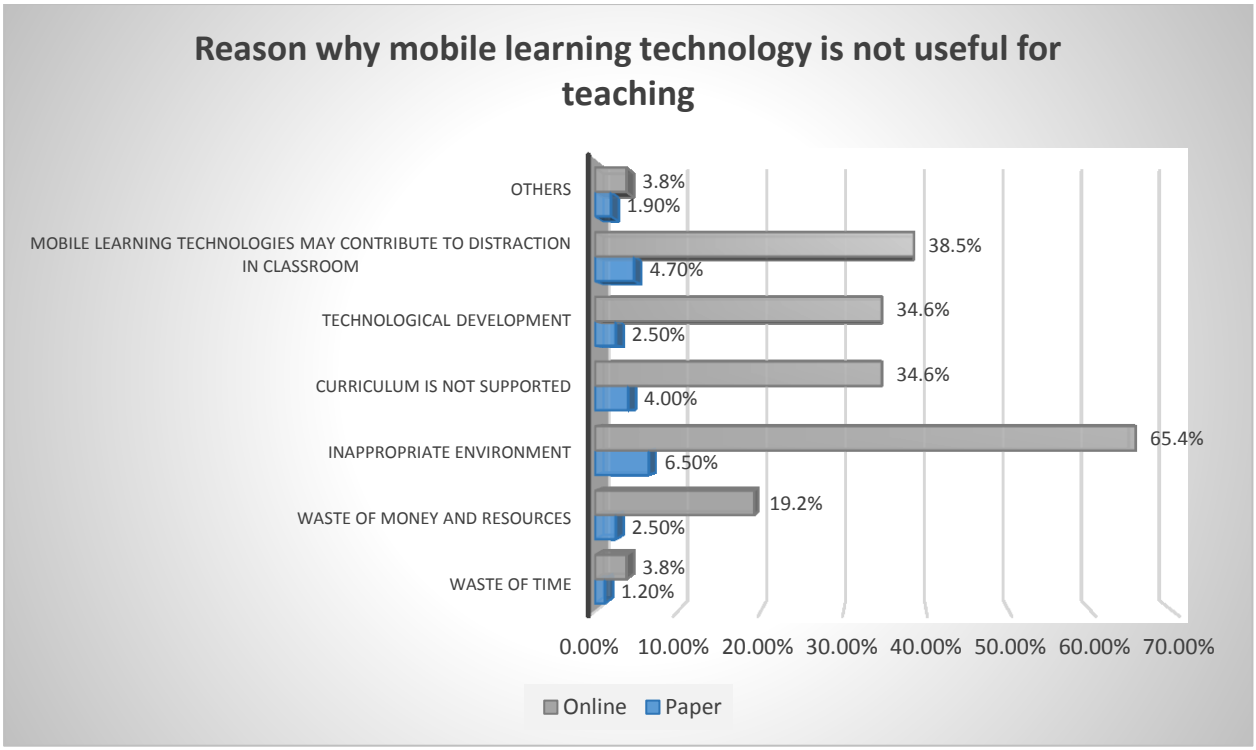

Figure 4.5 Why Mobile Learning Technology is not useful for Teaching?

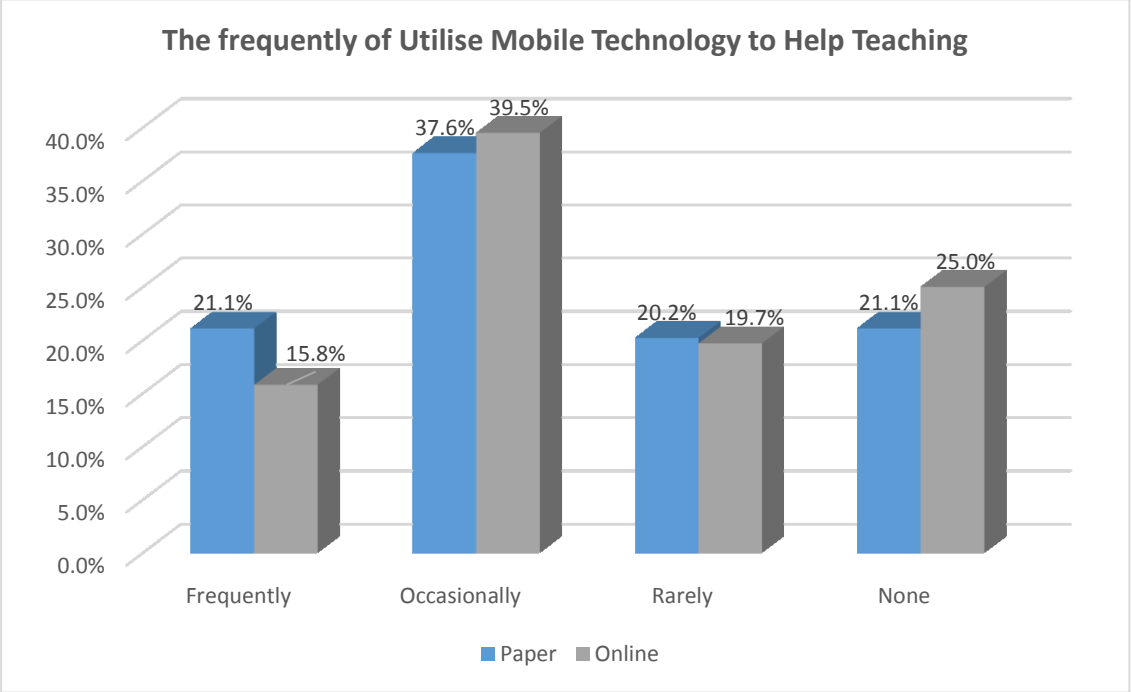

Figure 4.6 The Frequency of Mobile Technology Usage to Help Teaching

Figure 4.6 above reveals the frequency of mobile technology usage to help teaching. It can be seen that the majority of teachers use mobile technology occasionally for teaching with 37.6%, followed by teachers who use mobile technology frequently and some of them who do not use it. This has the same the percentages of these are 21.15% and 20.20% respectively; this result is similar to the online result.

Table 4.8 The Total of Teachers who like/dislike using Mobile Learning Technology for Teaching

Like to use mobile learning for teaching	Frequency	Percent
Yes	269	83.5
No	53	16.5
Total	322	100.0

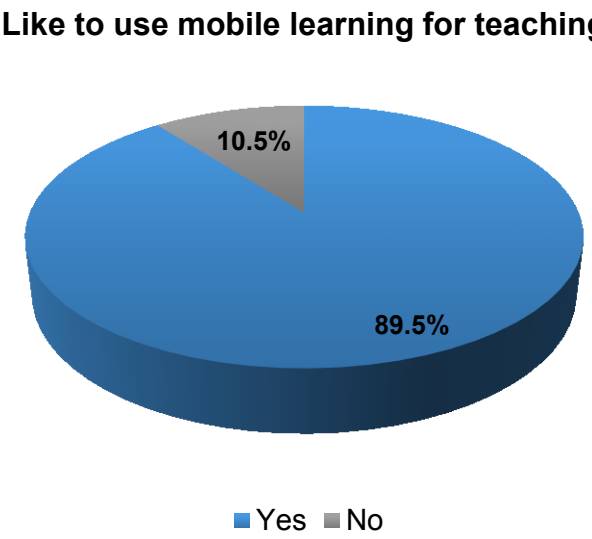

Figure 4.7 The Total of Teacher who like/dislike Using Mobile Learning Technology for Teaching (Online results)

When asked about liking to use mobile learning technology (Appendix A, question 2.9) total percentage of 83.5% of teachers answered that they enjoyed using mobile learning technology for teaching. Whilst 16.5% report that, they do not like using it (Table 4.8). Online survey results indicate a similar pattern (Figure 4.7). Therefore, it can be concluded that the majority of teachers preferred using mobile learning technology.

Table 4.9 The Opinion on the Validity of the Statements When Using Mobile Learning Technology for Teaching

Statements on your opinion to not like using mobile learning technology	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Total	Average (Mean)
1. Poor or no internet connection	5.30	9.60	33.90	35.70	15.50	100.00	3.47
2. Number of devices are not enough	5.90	10.90	28.00	36.30	18.90	100.00	3.52
3. Teachers lack the experience of using mobile technology	2.80	13.70	32.60	41.00	9.90	100.00	3.42
4. There is a lack of experts to teach how to use of mobile technology	5.60	7.80	31.10	38.80	16.80	100.00	3.53
5. Mobile technologies have limited use	1.60	15.80	39.80	36.30	6.50	100.00	3.30
6. Mobile technologies are very complex	3.40	18.30	42.90	28.90	6.50	100.00	3.17
7. Preparing contents for Mobile Technology is a waste time	6.80	33.20	39.40	18.30	2.20	100.00	2.76
8. Poor design of technologies features	3.70	30.10	49.10	16.50	0.60	100.00	2.80

Sharma (2012) used the following formula to calculate class interval width to define interval of opinion and Evaluation Criteria:

$$Class\ interval\ width = \frac{MaximumValue - MinimumValue}{Class\ desired\ number\ (K)}$$

Consequently, the average score criteria is as follows:

Average score: 1.00 - 1.80 refers to strongly disagree

Average score: 1.81 – 2.60 refers to disagree

Average score: 2.61 – 3.40 refers to neither

Average score: 3.41 – 4.20 refers to agree

Average score: 4.21 – 5.00 refers to strongly agree

Table 4.10 The Mean of Opinion on the Validity of the Statements When Using Mobile Learning Technology for Teaching

Statements on your opinion to not like using Mobile Learning Technology	**Average (Mean)**	**Summary Opinion Result**
1. Poor or no internet connection	3.47	Agree
2. Number of devices are not enough	3.52	Agree
3. Teachers lack the experience of using mobile technology	3.42	Agree
4. There is a lack of expert to teach how to use of mobile technology	3.53	Agree
5. Mobile technologies have limited use	3.30	Neither
6. Mobile technologies are very complex	3.17	Neither
7. Preparing contents for Mobile Technology is a waste time	2.76	Neither
8. Poor design of technologies features	2.80	Neither

Therefore, it can be concluded that the average teacher's opinions (Table 4.9 and Table 4.10) agreed the main drawbacks were poor internet connection, device not capable enough, educators' lack of experience and lack of experts to teach about using mobile learning technology. When asked about the opinion of mobile technology features the results are as follows: limited usage, complexity, and design of mobile technology features. Most teachers' opinions are "neither", it can be summarised that they do not have a problem about the mobile technology design features but they have a problem about infrastructure and lack of experts and experience in using mobile learning technology. It can be concluded that the survey results show a need for a model to guide the educators to determine the appropriate mobile learning technology when designing their curriculum contents. Teachers can be educated to use mobile technology more effectively in their teaching. The online survey shows similar results for using mobile learning technologies for teaching.

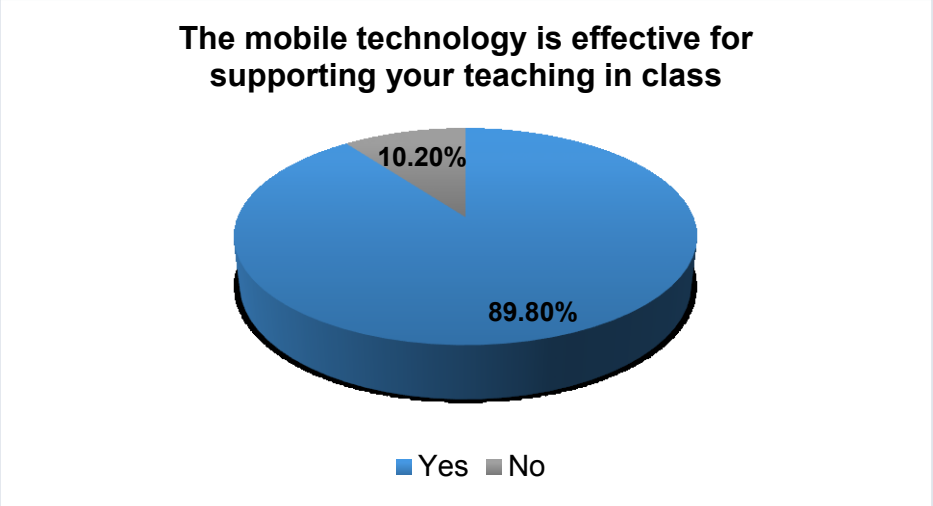

Figure 4.8 Mobile Technology is Effective for Supporting your Teaching in Class (Paper results)

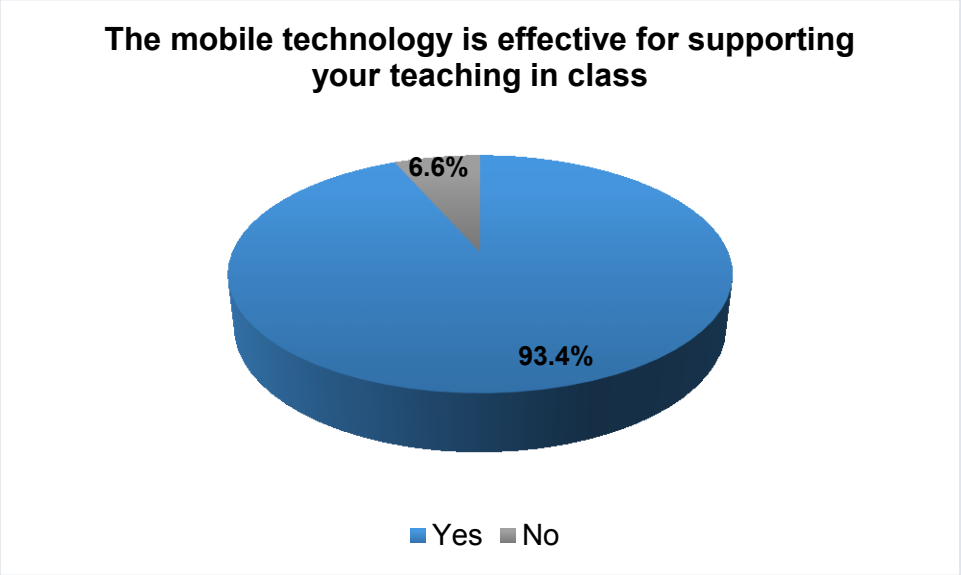

Figure 4.9 Mobile Technology is Effective for Supporting your Teaching in Class (Online results)

Figure 4.8 and Figure 4.9 above indicate the results of effectiveness in supporting teaching when using mobile technology in class. The paper and the online questionnaires show similar outcomes in that they are 89.80% and 93.40% effective in supporting teaching, whilst a small percentage is not effective in using mobile learning technology to support teaching.

Figure 4.10 and Figure 4.11 below present the reasons why mobile learning technology is effective in supporting teaching outside the classroom. A 62.40% of teachers suggest that students can review lessons by themselves (Paper result) and 59.20% (Online result). Mobile technology can increase communication between students and teachers with 33.90% and online data with 39.50%. While teachers answer other with 37.00% (Paper result) and 1.3%

(Online result) such as can motivate students to learn more, students have activity fun that can encourage knowledge and students can always learn.

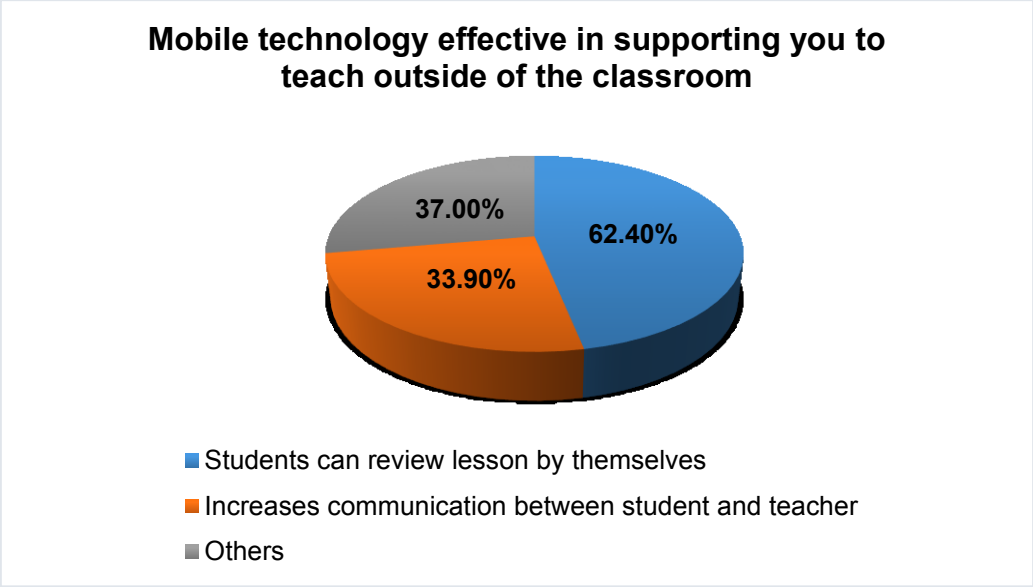

Figure 4.10 Mobile Technology Effectiveness in Supporting You to Teach Outside of the Classroom (Paper results)

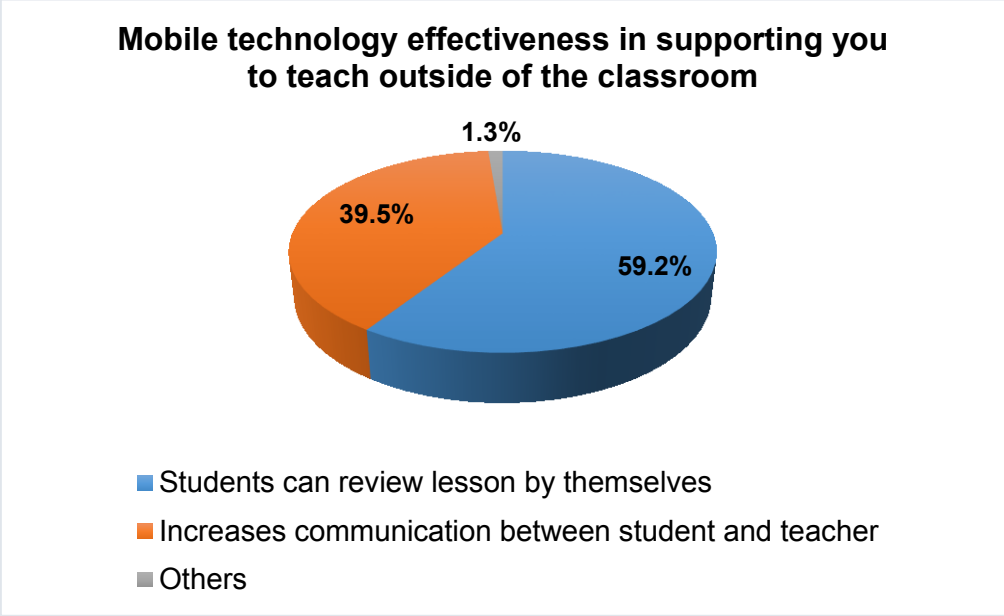

Figure 4.11 Mobile Technology Effectiveness in Supporting You to Teach outside of the Classroom (Online results)

The results indicated in Figure 4.12 below reflect that a total of 43.20% of the teachers gave the opinion that mobile technology is very good and significant in teaching materials which it can help students to understand (with 39.40% is good). From the mean value (mean = 3.46 see Appendix C), it can be concluded that most of the teachers in this research study feel that mobile

learning technology aids students to understand the curriculum content. The online survey results show similar results for teaching materials being good in helping students to understand with 42.1%.

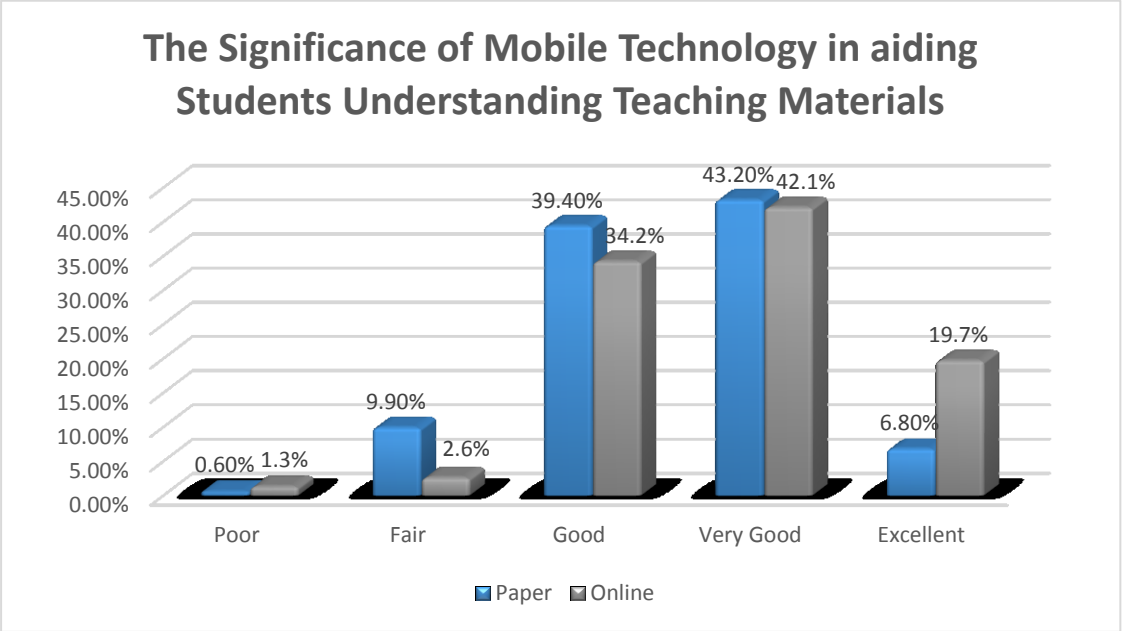

Figure 4.12 The Significance of Mobile Technology in Aiding Students Understanding Teaching Materials

Table 4.11 Importance Factors for Using Mobile Learning Technology

Statements of importance factors for using mobile learning technology	Not Important	Neither Important nor Unimportant	Important	Very Important	Extremely Important	Total	Average (Mean)
1. Suitable for subject area (Tan & Liu, 2004).	1.90	11.20	41.30	29.50	16.10	100.00	3.47
2. Facilitate (Tan & Liu, 2004).	1.60	9.00	35.10	40.70	13.70	100.00	3.56
3. Reduce time to teach (Mac Callum & Jeffrey, 2014).	1.90	11.20	45.00	32.90	9.00	100.00	3.36
4. Provide educational opportunities for learning (Korucu & Alkan, 2011).	1.60	5.90	29.50	43.50	19.60	100.00	3.74
5. Mobile learning technology can make materials interesting and easy to understand (Tan & Liu, 2004).	1.60	5.60	29.60	40.20	23.10	100.00	3.78
6. Mobile learning technologies are convenient (Mac Callum & Jeffrey, 2014).	1.60	7.80	33.20	43.80	13.70	100.00	3.60

Evaluation criteria uses the class interval width formula so as to define interval of opinion calculated by Sharma (Sharma, 2012).

Consequently, the average score criteria is as follows:

Average score: 1.00 - 1.80 refer to Not Important

Average score: 1.81 – 2.60 refer to Neither Important nor Unimportant

Average score: 2.61 – 3.40 refer to Important

Average score: 3.41 – 4.20 refer to Very Important

Average score: 4.21 – 5.00 refer to Extremely Important

Table 4.12 The Mean of Importance Factors for Using Mobile Learning Technology

Statements of the Importance Factor of using Mobile Learning Technology	Average (Mean)	Summary Opinion Result
1. Suitable for subject area	3.47	Very Important
2. Facilitate	3.56	Very Important
3. Reduce time to teach	3.36	Important
4. Provide educational opportunities for learning	3.74	Very Important
5. Mobile learning technology can make materials interesting and easy to understand	3.78	Very Important
6. Mobile learning technologies are convenient	3.60	Very Important

The data in Table 4.11 and Table 4.12 shows the results of factors for using mobile learning technology for teaching. When using the mean evaluation criteria, it can be concluded that the average of teacher's attitudes often have a high average of educators answering very important in suitable for subject area, facilitate, provide education opportunities, can make materials interesting, convenient and easy to understand while reducing the time to teach, teachers give attitude as important factors. It can be summarised that the most important factor when teachers are using mobile learning technology for teaching is that mobile learning technology can make materials interesting and easy to understand with a mean value equal 3.78. Online results indicated that all factors are important for teachers when they have used mobile learning technology for teaching. Online questionnaire results had shown a slight variation from the paper results. It can be seen that all factors have significance when choosing mobile learning technology for teaching (See Figure 4.13).

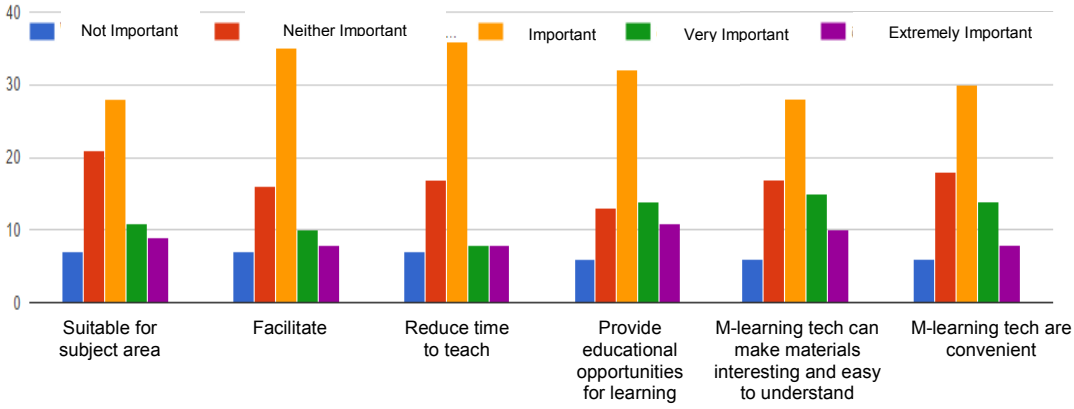

Figure 4.13 The Most Important Factors When Choosing Your Mobile Learning Technology for Teaching (Online Results)

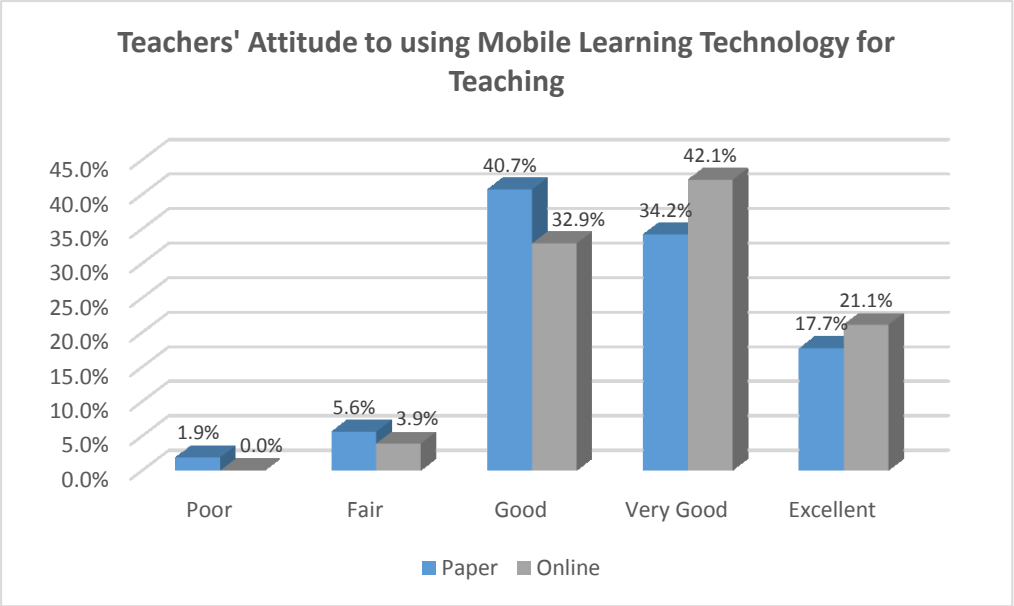

Figure 4.14 Teachers' Attitude to Using Mobile Learning Technology for Teaching

Figure 4.14, the results of educators reveal that teachers often have good attitude to mobile learning technology usage for teaching with 40.70% while their response from online results shows different results for mobile learning technology usage are very good with 42.10%. That is, most teachers are interested and feel positive about using mobile learning technology for teaching.

Table 4.13 Teachers like/dislike to Have More Teaching Materials Available on Mobile Technologies

Teachers like/dislike to have more Teaching Materials available on Mobile Technologies	Frequency	Percent
Yes	294	91.3
No	28	8.7
Total	322	100.0

Table 4.13 includes teachers' opinion about the teaching materials on mobile technologies. According to the survey results, there is a higher percentage of yes with 91.30% whilst 8.70% are answer no. These percentages are similar patterns to online survey results (Figure 4.15)

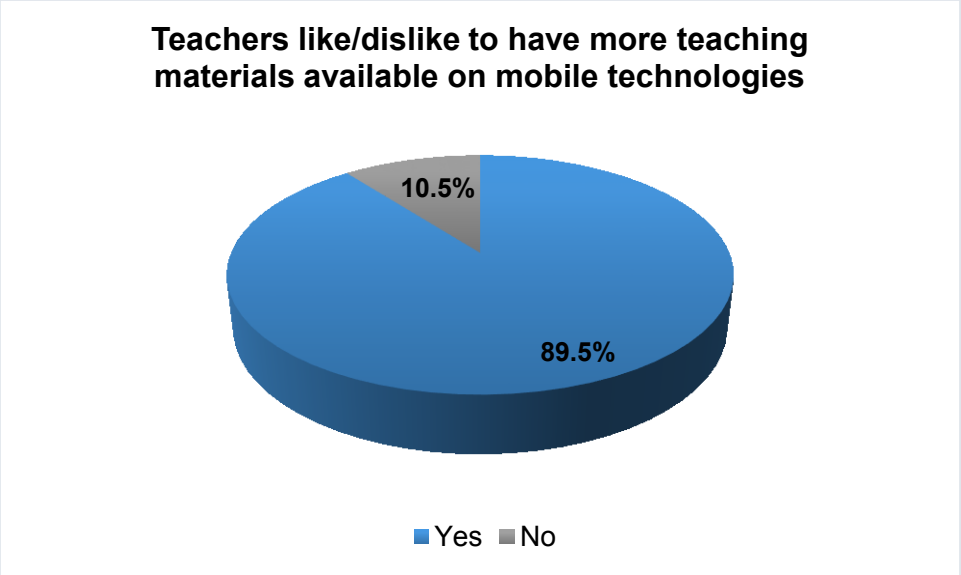

Figure 4.15 Teachers like to Have More Teaching Materials Available on Mobile Technologies (Online results)

Table 4.14 Teachers like to be Able to Interact with Your Learner via Mobile Learning Technology Regarding Concerns Related to the Curriculum

Teachers like to Interact with your Learner via Mobile Learning Technology	Frequency	Percent
Yes	280	87.0
No	42	13.0
Total	322	100.0

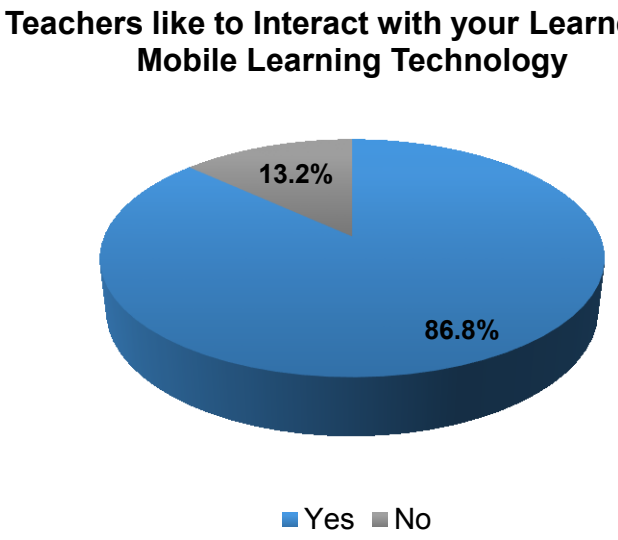

Figure 4.16 Teachers like to be Able to Interact with Your Learner via Mobile Learning Technology regarding concerns related to the Curriculum (Online results)

Regarding Table 4.14 and Figure 4.16 show that most teachers (with 87.00% - Paper result and 86.80% - online result) like to be able to interact with their students via mobile learning technology and they need it to be related to the further curriculum. While referring to the question about what is a teacher's attitude concerning the mobile learning technology usage in teaching, the data results also reveal that there is a similar result between the paper result and online result. Figure 4.17 and Figure 4.18 provide the opinion of teachers towards using Mobile Learning Technology in teaching. According to the results, a small percentage of the educators report that there is a negative attitude (4.0%) in using Mobile Learning Technology. The 45.40% state their opinion as Neutral while 50.60% have a positive attitude using mobile learning technology. It can be concluded that the majority of the teachers have a positive attitude when they use mobile learning technology in teaching.

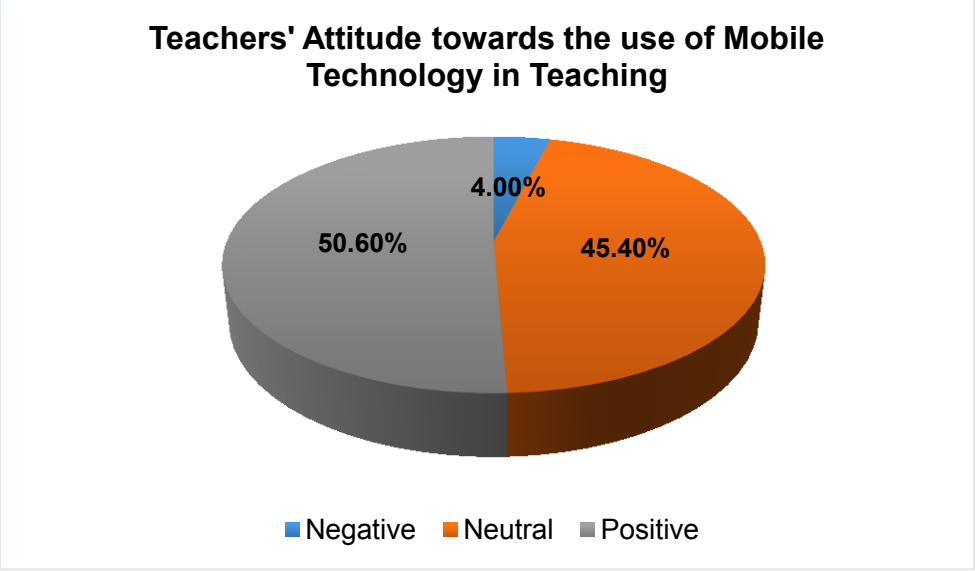

Figure 4.17 Teachers' Attitude towards the Use of Mobile Technology in Teaching (Paper results)

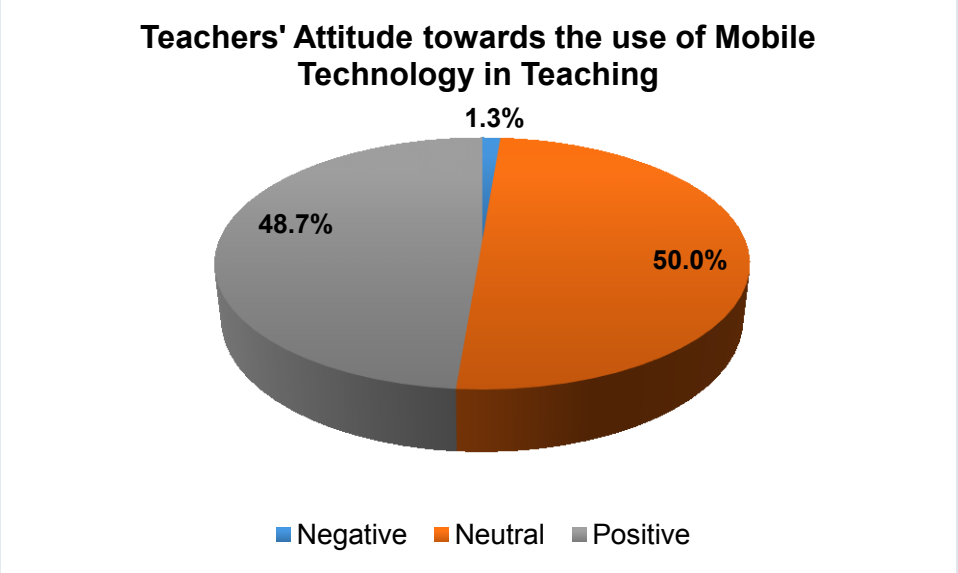

Figure 4.18 Teachers' Attitude towards the Use of Mobile Technology in Teaching (Online results)

Table 4.15 Number of Respondents' Open-ended Question

Number of respondents Open-ended question	Frequency	Percent
Answer	27	6.78
No answer	371	93.22
Total	398	100.00

The last question in the questionnaire invited participants to add further comments on using mobile learning technology for teaching. The participants have responded to open-ended questions with 6.78% making comments. However, 93.22% did not include any comment (See Table 4.15). The teachers' comments are summarised in the section below:

1. Teachers need training and guiding in mobile learning technology usage in order to develop themselves, which will encourage teachers to be better at teaching before using in curriculum teaching. According to the survey results, this is a particularly important issue for teachers who are 50+ years old and they reported their need for support and guidance in using mobile technology. These findings are similar to O'bannon and Thomas (2014), who stated, that teachers over 50 years perceived mobile technology for teaching as being more problematic than did younger teachers.
2. Teachers prefer to receive mobile technology training in order to develop their subject curriculum contents.
3. According to the survey results, using mobile learning technology for teaching is good for both students and teachers. The main reason is to motivate student learning and interest. Moreover, teachers' survey results indicated that the two important elements of their decision to adopt mobile learning technology usage are (1) the appropriate time and (2) selecting lesson topics.
4. Schools/education organisations should encourage and provide budgets for mobile learning technology usage such as internet connection systems, innovative design to motivate learning behaviour of students and clear usage guidelines for mobile learning technology.
5. Features/applications should include better-designed menus in pictures or texts in order to support teachers.

6. Mobile learning technology can be used in the classroom or outside the classroom and this can increase learning opportunities for pupils, and thus, reduce the gap of learning. Students can get more data/contents from the mobile learning technology, and they can be comfortable in their learning and self-learning and can be encouraged as a result of adopting mobile technology.

4.1.3 Discussion

The study presented in this section provides the background for the requirements of mobile learning technology in order to develop a decision support model for mobile technology enhanced teaching. The findings of this research study have indicated that:

- The features/applications of mobile learning technology that educators are currently using includes pictures, review/practice, games, quiz, and animation.
- The majority of teachers preferred using mobile learning technology and their reasons to use this technology included; to improve pupils' learning, to motivate students to study in both classroom and outside classroom and to improve the effectiveness of teaching.
- The important factor when educators used mobile learning technology is that it can make materials interesting and easy to understand.
- Guidance and training in using mobile technology are necessary for teacher training. Teachers need a model to use mobile learning technology so that they can improve the quality of their teaching.
- Mobile learning technology can support educators' teaching and can make appropriate activities of learning fun for the pupils.

According to the survey results, we can indicate that the problems are that teachers lack guidance and training or have had inadequate training in using mobile learning technology. This is a similar finding to Yusof et al. (2011); Mohd Yusof et al., (2014) studied the teachers' perceptions of using mobile technology in the classroom for teaching. The findings of their study were that teachers face problems and challenges in the use of technology, in particular, the teachers felt that they have limited knowledge and lacked the knowledge,

experience, and skills of how to integrate the use of mobile learning technology into their teaching. Regarding teachers' interview results, Kafyulilo (2014) indicated that the majority of teachers needed training in order to know how to use mobile technology to facilitate teaching, which can make them hesitant to use mobile technology for teaching.

Consequently, training and guidance are necessary before teachers use mobile technology for teaching. Similarly, Bitner and Bitner (2002); and Ertmer, (2005) have stated that teachers need guidance and training in order to effectively use mobile technology in teaching. This view is supported by Ally et al. (2014) who stated that guidance and teacher training are necessary for teachers in the use of mobile learning technology, especially older teachers over 50 who may be more problematic with regard to the use of mobile phones for teaching in the classroom (O'bannon & Thomas, 2014). In order to solve these problems, developing a new model for supporting and guiding teaching can therefore be beneficial for educators in planning and delivering an educational system suitable for primary education, to reduce the gap of education difference and encourage educators to be more effective when using mobile learning technology at teaching. In addition, the findings are proposed as helpful to develop a decision support model of MLT that can assist and guide teachers in using MLT in their classroom and assist school managers in designing an MLT curriculum (Christensen & Knezek, 2017).

4.2 Data Analysis of Qualitative Data

In the previous section, the results of the questionnaire have been discussed. It can be concluded that, guidance and training in using mobile technology are necessary for the teacher. Teachers really need a model to guide the use of mobile learning technology that can assist them to improve the quality of their teaching. In addition, mobile learning technology can support educators' teaching and can make appropriate activities of learning fun for the pupils.

This section will continue to investigate an in-depth understanding of the requirements of mobile learning technology use for teaching. The data in this section presents qualitative data collected through semi-structured interviews. Thematic analysis was used to present the interview results.

4.2.1 Data Collection

The sample for this study was 15 primary schools from various parts of Phitsanulok Province in Thailand. Both urban areas and rural areas were selected for the qualitative data analysis. The group of respondents, consisting of teachers and school managers, were invited to semi-structured interviews, where they were asked about their opinions of and attitudes towards using Mobile Learning Technology at their school. In the case of teachers, they have taught with MLT. In the case of administrators, they have developed curricula with MLT.

The selection criteria for selecting the interviewee sample for the semi-structured interviews were based on the completed questionnaires (Questionnaire for the Requirements of Mobile Learning Technology). Teachers and school managers, who had experience and familiarity with the use of mobile learning technology for teaching and delivering curriculum at their school, were asked if they would like to participate in semi-structured interviews for this study. Therefore, the total number of participants in this semi-structured interview were 17 teachers and 10 school managers.

4.2.2 Data analysis

In this section, the data is analysed by using thematic analysis of the interviewee transcripts in order to provide an in-depth understanding of individual participants. Results of the interviews were divided into two groups for examination: interviews from urban areas and interviews from rural areas.

Key Themes

Thematic analysis was applied to the audio responses of all interviewees, and themes were identified within the interviewees' perspectives on using mobile learning technology at their school. There were five themes, including further subthemes, within the teacher responses and two themes, again with further subthemes within the administrator responses.

Final Thematic Map of Teachers' Perspective

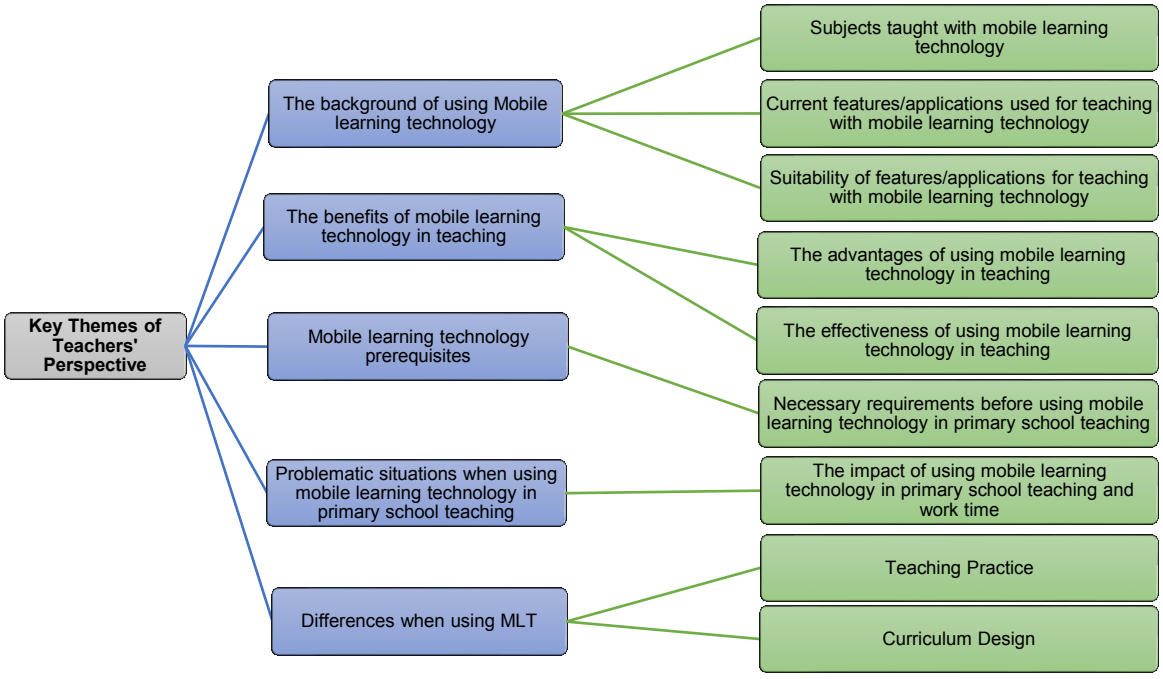

Figure 4.19 Final Thematic Map of Teachers' Perspective

Key Themes Details from Teachers' Perspective

Theme 1: The background of using Mobile Learning Technology

The background of using mobile learning technology in teaching was a key theme in both areas (urban and rural areas). Within this theme, three sub-themes emerged which provided a deeper understanding of using mobile learning technology. The three sub-themes are:

Sub-theme 1: Subjects taught with mobile learning technology

Sub-theme 2: Current features/applications used for teaching with mobile learning technology

Sub-theme 3: Suitability of features/applications for teaching with mobile learning technology

Theme 2: The benefits of mobile learning technology for teaching

Benefits appeared as a second theme related to the use of mobile learning technology in primary teaching. This theme contained two further sub-themes:

Sub-theme 1: The advantages of using mobile learning technology in teaching

Sub-theme 2: The effectiveness of using mobile learning technology in teaching

Theme 3: Mobile learning technology prerequisites

The requirements of mobile learning technology in teaching are a significant aspect of this study. This emerged from the need to determine the appropriate mobile learning technology when designing curriculum content. Within this the sub-theme is:

Sub-theme 1: Necessary requirements before using mobile learning technology in primary school teaching

Theme 4: Problematic situations when using mobile learning technology in primary school

This theme concentrated on the problem situations of using mobile learning technology in primary school. The single sub-theme of this theme is:

Sub-theme 1: The impact of using mobile learning technology in primary school and during work time

Theme 5: Differences between using MLT and more traditional methods

Different teaching approaches were a theme that concerned traditional classroom teaching and mobile technology teaching. This theme consists of two sub-themes:

Sub-theme 1: Differences related to the practicalities of Teaching

Sub-theme 2: Differences related to curriculum design

The Perspectives of Teachers in Urban Areas

Theme 1: General background information about using Mobile Learning Technology

Sub-theme 1: Subjects taught with mobile learning technology

Teachers interviewed from urban areas answered that the two subjects in which mobile learning technology was most used in primary school teaching are Thai Language and Mathematics. The other subjects for which teachers used mobile learning technology included English language, Sciences, History, Social Studies and Health Education.

Some interviewees stated that they use mobile learning technology as a supportive teaching material because it can increase student interest and motivate students.

Sub-theme 2: Current features/applications used for teaching with mobile learning technology

Teachers interviewed from urban areas also revealed that the majority of features/applications used in the mobile learning technology were “games” which can support and encourage student learning, ease of understanding and independent learning. Games make useful teaching aids, because they are colourful and their content is engaging.

Below we present some teachers’ opinions that were collected concerning the use of games as teaching aids in mobile learning technology:

Teacher K2 said: “I have used games to help students prepare for quizzes in Mathematics, encouraging students to practise and think for themselves, which makes learning easier and fun”.

Similarly, teacher P9 said: “I have used games and stories in science subjects, because they work well for science. These subjects deal with experiments, and I have used games as teaching aids so that students can see virtual reality pictures and learn independently. This helps make lessons easier to understand.”

Other common uses of MLT in the urban classrooms are applications for delivering practice exercises, reading material, and quizzes.
Here are some of the teachers' reasons for using these applications.

Teacher B1 said, "I use MLT for practice exercises and sometimes quizzes because students can independently review the knowledge and skills they have learned in class. This will stimulate students to better remember things and have better recall of their knowledge". Other urban teachers indicated that quizzes are helpful in social studies, since there is a lot of material in social studies that needs to be reviewed and practised.

Teacher S1 stated that "I use English readings with audio features. This really helps student practise and improve their pronunciation. They can practise alone even at home or when the teacher is not nearby. That can make a big difference, encouraging students to take their skills to a higher level".

Pictures and animation have also been used in mobile learning technology. A good picture or animation can help draw and retain students' attention, and since a picture can be worth a thousand words, they are good tools for explaining material efficiently and for giving examples.

Sub-theme 3: Suitability of features/applications for teaching with mobile learning technology (Matching features/applications to fit the classroom)

Results from urban teacher interviews indicated that mobile learning technology is a particularly useful resource for providing supplemental learning materials to reinforce the standard primary school curriculum. Here are some comments from teachers on matching MLT material to fit their classroom:

Teacher P9 said, "Some MLT features are a good match for young students, and it is important to always keep in mind who your students are, what they need, and what they can do, in order to choose correct applications for them. Also, the older the students, the greater their abilities and attention spans, so even more MLT material is useable for older students."

Teacher P4 said, “It's also important to match the MLT material with the subject being taught. For example, games and videos work well for practising vocabulary and pronunciation in English class, and audio-visual material also works for social studies, for example using music and song to learn about and think about Thailand’s King and Thailand’s Royal Family.

Theme 2: The benefits of teaching with mobile learning technology

Sub-theme 1: The advantages of using mobile learning technology in teaching

When asked about the advantages of using mobile learning technology in teaching, the majority of participating teachers expressed the view that the use of mobile learning technology in teaching can develop and encourage students’ learning because students gain more experience, more skills, more individual practice and some of the things they learn can be reapplied to other school subjects. They can also independently develop their skills and creativity.

Teacher P5 felt that, “using mobile learning technology in teaching, the pupils can gain more experience and skill. In addition, it engages students. They have fun, and they want to learn more when they use mobile learning technology”. This opinion was directly related to teacher P8’s views that “I think that students will have more experience, so they can learn quickly and can practise on their own”.

Moreover, Teacher A3 agreed that “teaching with mobile learning technology can help and improve students’ learning. It increases their interest in learning, helping to encourage and develop their experience”.

Teacher P7 said that “Students can pre-emptively solve problems by themselves before resorting to requesting assistance” and teacher P9 presented that “teaching with mobile learning technology can expand students’ worldview as well”.

Students will learn about new technologies, and ease of understanding and convenience are secondary advantages related to the use of mobile learning technology. Teachers stated that mobile learning technology could aid teaching in terms of reducing the workload of teachers. In fact, it can be similar to having

a teacher assistant. It can help motivate students to learn more. In addition, it is good for providing practice, and can help students had better remember material. Teaching with mobile learning technology can also motivate students to be active in their learning. This can lead to improved thinking. From interview results regarding students learning new technologies, here are some viewpoints that teachers provided:

Teacher K2 said that “teaching with mobile learning technology stimulates students, builds their interest in learning more”. That is related to teacher P4 revealing that “not only does this program foster student interest and enthusiasm for new technologies, it also widens students’ experience, and makes learning fun”.

In the interviews, teachers had various perspectives on how MLT helps students understand lessons while also providing convenience for teachers. For example, teacher P9 stated that “MLT can help reduce the burden of lesson planning for teachers. Moreover, it still helps students better understand and be more interested in the lesson contents, because details of the lesson material like pictures or animation make it easier for the students to understand”.

This point is the same as teacher A3, who said “I think, using mobile learning technology in teaching can aid the teacher, and students often prefer learning with MLT to learning with traditional textbooks/classrooms”. Teacher P8’s interview supported that. She said “It’s as if there are digital teacher assistants, because mobile learning supplies additional teaching media”.

Sub-theme 2: The effectiveness of using mobile learning technology in teaching

The application of mobile learning technology in teaching emerged as a second sub-theme related to the usefulness of MLT. Most of the participants in the urban area interview group described mobile learning technology as effective when used as additional teaching media.

Teacher B1 said “I use textbooks to explain the basic lesson content to students. After that I use mobile learning for review, having students repeat and

practise what they have learned in order to improve their skills and understanding". Similarly, teacher P4 explained that she, too, uses mobile learning technology as additional teaching material. "I have to plan and manage lesson material, deciding which material will probably work best from a textbook and which material will probably work best from MLT. MLT is especially well suited for the subjects I teach, which are Thai and English language. I teach about language English which involves learning a lot of new vocabulary, and both languages involve learning irregular spellings. I use not only textbooks but also mobile learning technology as an additional teaching media, because it can encourage students be more effective in their learning".

One of the teachers in this interview also raised an interesting point. Teacher P9 said "I use mobile learning technology for additional teaching by using stories and games so that learning becomes fun and students can understand more. MLT is helpful when students in the class have widely varying ability and interest levels."

Furthermore, teacher S1 said, "I use mobile learning technology in my class because textbooks by nature cannot show movement or other vivid reality. For example, in science class, the textbook lesson on plant growth just explains written details and shows a simple photo, however while teaching with mobile learning, students can see the actual movement during plant growth, which makes the concepts easier to understand".

Nevertheless, teacher P7 reflected that "the effective use of mobile learning in teaching depends on each teacher's technological savvy. For instance, some teachers with especially limited knowledge of technology might run into glitches and not be able to resolve them quickly. This situation can waste time for teachers and students".

Theme 3: Mobile learning technology prerequisites

Sub-theme 1: Training required before using mobile learning technology in primary school

The prerequisites necessary for mobile learning technology is a theme that participants brought up regularly during interviews, and this theme has been divided into three main topics here: training, guidance/documents and applications.

First, according to the interview results, the majority of teachers said that "training" is required when they have to teach with mobile learning technology. They want an organisation or school to train them thoroughly before using mobile learning technology in school.

Teacher P9 stated "I would like one of the devices sent to me in advance so that I can try it myself and learn how to use it myself before needing to teach my students. If I receive advance training, I can ask about problems that I encounter and solve them beforehand, so that in a real teaching situation, when I face a problem using the device, for example, I hope that I can solve it on my own. This avoids wasting class time".

All the participant teachers in urban areas agreed that they would like several training sessions. Teacher B1, for instance, said "I would really like some training in the beginning and also regular software updates." Similarly, teacher S1 said that "The company involved in distributing the mobile learning technology should designate a trainer to initially visit our school in order to train us and then follow up at least two or three times per month to help solve any problems teachers run into".

Another reason why teachers need more than one training session is that some teachers are quite old. For example, Teacher P7 said "There was training but not enough. I would really like additional training because some of us teachers are not young and we could really use more time to remember all the procedures used for mobile learning technology. I think it would be a good idea to have one teacher at the school who has good MLT skills and can train the

rest of us. Teachers should also have a chance to get together to discuss and exchange their experiences using MLT". That opinion is very similar to teacher P5's. She explained, "I would like more training, because some older teachers have difficulty using technology in the beginning. In addition, the Ministry of Education could send an expert to explore the requirements and problems that teachers sometimes meet when using mobile learning technology".

Some participants proposed more follow up by the company in charge of the training. Some of the teachers also suggested not only training for the teachers but also some training for students' parents as well. Teacher P8 explained that "when students go back home, parents should know how to assist their child. I think this will lead to effective learning both at school and at home".

The second main topic in the training subtheme is that more documentation and guidance should be made more available as needed, when teachers have to use MLT. Teacher P4 offered that "before using new technology such as mobile learning technology in the classroom, there should be more guidance and documents or experts to provide advice on the use of mobile learning technology in primary school".
Another suggestion from some of the educators was that the contents of mobile learning technology should be updated at least once a month.

Lastly, one more requirement mentioned for teaching with mobile learning technology is additional features and applications. Teacher P6 recommended, "It would be nice to have ready-made pre-tests and post-tests in lessons in order to gauge students' progress. This will help us know how to teach students effectively". Furthermore, teacher P8 said "If possible I'd like to have more content available in each lesson, for example a variety of games in order to motivate students and increase their understanding".

Theme 4: Problems that arise when using mobile learning technology in primary school

Sub-theme 1: The impact of using mobile learning technology in primary teaching and work time

During the interviews, most of the problems that teachers described experiencing while using MLT were actually external factors such as quality-issues with the distributed devices and unreliable internet connections, factors which were difficult to control and which wasted time.

Teacher K2 explained, “Some devices would not connect to the internet which sometimes wasted a lot of classroom time. Also my school is really large, and there are so many students that it is quite difficult to manage all the students’ MLT experience, and it is also difficult to maintain so many devices”.
Teacher P5 agreed. “It is difficult to control students, given the large size of the school and also the urban environment. Class sizes can be very large, making classes harder to control. I would like to suggest that the curriculum be designed with particular study hours reserved for mobile learning in a timetable each day. Large classes could also be broken up into smaller groups during those “mobile learning hours” and they could meet in separate rooms so that teachers can concentrate on MLT during that time and give students more individual attention”.
This point is similar to teacher A3, who stated that “Sometimes some students don’t pay attention to the mobile learning lessons when I’m explaining things to them. They can become difficult to control. Our very large class sizes make this almost inevitable”.

Other problems using MLT that were mentioned included wasted class time and students being distracted by other features and applications on their device. Teacher P9 said “Some students don’t concentrate on the lesson because the mobile learning devices have many features and applications, and some students start playing games on their devices or jumping to different lessons not currently being discussed. This is a factor beyond the control of the teacher. This is another reason that having “teacher assistants” would really make things

smoother". Teacher P4 and teacher P8, brought up a related viewpoint, saying that differences in devices among students can make classes harder to control. If all the students' devices are not of equal quality with equal capabilities. When using MLT, effective learning requires the availability of effective devices.

Theme 5: Different teaching approaches

Sub-theme 1: Differences related to the Practicalities of Teaching

Regarding the practicalities of teaching, almost all the interview participants in urban areas indicated that there were a few differences between classroom teaching and mobile teaching. Teachers said that they teach with a textbook to explain each lesson's main material, and they use mobile learning as additional teaching media. That is to say, mobile learning technology keeps students attentive and more interested.

Teacher P5 said, "The two ways of teaching are not that different, mobile learning works well as additional teaching media because young children have to practise writing and spelling. So I use mobile learning to help with additional reading and for viewing pictures. I also often teach by combining both traditional teaching and mobile teaching. This leads to more especially effective teaching".

Teacher P9's responses supported teacher P5's. She said, "Using mobile learning technology increases student interest. While in the classroom and using a textbook, teachers focus on the main theories of each lesson. Beyond that, we use a variety of mobile media as teaching aids so teachers do not have to produce so much extra material on their own. For example, I use mobile learning when teaching about plant growth so that students can actually see the plant moving". On the other hand, teacher K2 reflected that "teaching and learning from textbooks, teachers can see students' handwriting and get a feeling for the students' development, while mobile learning usually happens more quickly and for a shorter time, so there is not the same feeling of following a student's progress".

It can be seen, therefore, regular classroom teaching and mobile learning are compatible. Teachers have had good experiences using mobile learning as

teaching aids (e.g. for additional teaching media). In other words, they should teach by combining both traditional methods and mobile learning technology. These two methods are mutually supportive.

Sub-theme 2: Differences related to curriculum design

Teachers have various perspectives regarding designing curriculum and lesson plans for traditional teaching versus mobile learning. Most of the teachers felt that it was more difficult for them to prepare and design a curriculum and lesson plans for mobile learning. On the other hand, some teachers felt designing curriculum and lesson plans for mobile learning more comfortable.

Teacher K2 stated “Mobile learning can be difficult to prepare for, because it’s dependant on the devices and also on their reliability. It’s better for both teachers and students if the devices are really ready to use and have been pre-tested for correct functionality.” Teacher B1 said “With mobile learning, I have to spend more time trying out the material and learning it myself on the device before teaching it to my students. However when teaching from a textbook, I’m usually able to just walk into the classroom, open the book, and begin teaching immediately”.

Some teachers revealed that it is actually easier for them to design a curriculum for mobile learning. Teacher P7 said “If I use mobile learning for teaching, I don’t have to prepare the devices. That is to say, I can use pictures or other media from the mobile learning applications. While preparing for the classroom, I prepare all my own materials, including interesting stories or games.” Similarly, Teacher P4 said, “For classroom teaching, I have to prepare the whole lesson plan, including documents and assignments. While using mobile learning technology in teaching, I need to try out the material on my own before teaching it, to make sure I understand the application”.

Based on the results of interviews with teachers from urban areas, it seemed that curriculum design for traditional classroom teaching was easier, due to teachers having more expertise managing a classroom than managing

technical devices. During curriculum design for mobile learning technology, teachers need to learn and check the material themselves in advance. Furthermore, teachers' experiences can also depend on the skills and the age of each teacher. Therefore, guidance and training are vital for teachers when they use mobile learning technology.

The Perspectives of Teachers in Rural Areas

Theme 1: General background information about using Mobile Learning Technology

Sub-theme 1: Subjects taught with mobile learning technology

Interview participants from rural primary schools indicated that the class subject most often utilising mobile learning technology in their schools is Thai language. The next most common subjects where MLT is used are: Mathematics, English language, Science, and Social Studies.

One of the teachers also made an interesting point. She said, “I use mobile learning as supplementary media. For example, in English class I use English cartoons, because students can pronounce the words as they watch. It’s interesting for them”. It appeared that teachers use mobile learning technology in class because it can make material easier for students to understand and it can help maintain their interest.

Sub-theme 2: Current features/applications used for teaching with mobile learning technology

Looking at interview results from teachers in rural primary schools, the way that MLT is most often employed there is in the form of games. These results are similar to the interview results from urban schools. The teachers’ attitude was that MLT games could encourage and motivate students. Teacher P1 said, “I use games in conjunction with textbooks in order to encourage and enhance student learning”.

Additionally, many features/applications other than games have been used in mobile learning technology such as practice exercises, quizzes, pictures, reading material, videos and other media. Some of the teachers felt that practice exercises are particularly suitable for mathematics classes.

Teacher P2 said, “I have used games and quizzes with mobile learning technology, and I have used paint applications for students to create pictures in art classes, which students have fun with”.

Teacher A2 said, “I have used reading passages in English classes to practise pronunciation and build vocabulary. Students can practise by themselves at home or anywhere”.

Teacher P3 said, “For English and Thai classes, I have been using videos because students can follow along and pronounce words in the cartoon video that they watch. In maths classes, teachers will assign MLT homework to reinforce newly learned knowledge as games. Using mobile learning technology keeps students interested and engaged in the material that I teach”.

Sub-theme 3: Suitability of features/applications for teaching with mobile learning technology (Matching features/applications to fit the classroom)

Looking at the interview results, about teachers’ perspectives on applications suitability for MLT use, most of the teachers stated that the reason why they have used mobile learning technology in class is that the applications work well with the class subjects and the contents are related to the textbooks. This helps motivate students, making studying more fun. Here are some examples that teachers gave of which applications are most appropriate for mobile learning technology.

Teacher N1 said, “I have taught with mobile learning technology because it is effective with primary school subjects, particularly English, Thai, and Maths. Also the mobile learning content was related to the textbooks. MLT can motivate students and improve their learning and understanding.”

Teacher K1 thought, “I think MLT games are good for science subjects because students can see real-life examples, for instance using time-lapse videos such as plants growing in fast motion”.

At the same time, some teachers had different perspectives. Teacher A2 suggested, “My experience is that MLT doesn’t really work that well with young kids, because the devices themselves distract the kids, and they can’t concentrate on our lesson for a long time”.

Theme 2: The benefits of teaching with mobile learning technology

Sub-theme 1: The advantages of using mobile learning technology in teaching

The results from the teacher interviews revealed various advantages of teaching with mobile learning technology. The teachers found that using MLT can stimulate and develop students' thinking. It can motivate students to practise more, and they can review material by themselves. Moreover, they can quickly search for content that they want to know more about. MLT can also be convenient for the teacher, sometimes reducing prep time.

Teacher N1 said, "MLT makes students want to learn, because there are pictures, sound effects, music, and other interesting content. Students become more interested and have a good time while learning. Also the variety of applications can stimulate and develop students' thinking".

Teacher K1 explained, "Students can see real pictures and video clips, which help them better understand what's in the textbooks. In addition, MLT can help develop students' thinking so that they can have more opportunities and experiences." Teacher A2 said, "Mobile learning technology can develop and improve students' learning and help expose students to more experiences".

Teacher P1 agreed. She said "Students' skills have improved. They learn to be more patient because I set limits on using the devices. I don't allow them to just use the devices any time. They are excited and have fun when they do get to use the devices, since they've been waiting. MLT can also encourage student creativity, which is something that can help them in daily life".

Some teachers provided their opinion on the advantages of using MLT as follows.

Teacher A1 said "Students are able to access and read the MLT material on their own, reducing the time they are taught directly by the teacher. Students also build self-confidence from reading and thinking on their own." Teacher P3 added, "For example for maths lessons, there are practice exercises and games for students to think through by themselves. For English lessons, sometimes I cannot pronounce English words correctly myself, so I use video media from MLT as a model for pronunciation. Students can listen to the audio,

try pronouncing the sounds themselves, and repeat this process as many times as they want. MLT is great resource that enhances the regular classroom experience".

Sub-theme 2: The application of mobile learning technology in teaching

Results of the teacher interviews indicate that the majority of teachers in rural areas find mobile learning technology most effectively when used as supplementary teaching media after the regular classroom lesson has been taught.

Teacher P1 expressed the view, "To teach effectively, I find it important to link and adapt the MLT material both to the regular textbook lessons and also to the abilities of the students themselves. I use MLT mostly as supplementary learning material".

Teacher N1 said, "I have to look over the regular lesson material and consider which material lends itself to supplementation with MLT. When handled carefully, MLT can encourage and motivate students to learn. For example, in maths class, I used the features and pictures of MLT to help students learn basic counting, addition, and subtraction".

Teacher P2 suggested, "In order to effectively use MLT, teachers need to be in close communication with their students. Sometimes students have problems when they learn with MLT. The sooner I hear about issues they are having, the more quickly I can help them resolve them".

Theme 3: Mobile learning technology prerequisites

Sub-theme 1: Training required before using mobile learning technology in primary school

Interview participants emphasized that they would like and they need additional training in MLT besides the single, limited training they received. They need this additional training before using mobile learning technology in class in order to maximise the effectiveness of the MLT program for students. Second, they really feel a need for additional funding to set up necessary infrastructure like school-wide internet connection equipment. Teachers also say that well-qualified support staff need to be made available to improve the use of MLT when teaching.

Another recurring comment during the interviews was that most of the teachers in rural areas felt that they had insufficient knowledge and skills to use mobile technology to its full potential. Therefore, there were many calls for additional training.

Teacher A2 indicated, “I really need more than just one training session. Training only one or two times is not enough because some older teachers with less computer experience cannot keep up with more computer-savvy young people. Periodic training, say, at least once a term, would help. Also a guide book would be useful and helpful”.

Teacher P1 said, “I need more training, especially more training introducing the use of mobile learning technology for class. I would like an expert to come follow up on a regular basis to continue the training. I’d also like the liaison company to take more care of the internet connectivity infrastructure and the devices themselves”. These opinions are similar to teacher K1, who also said she needs more training and more follow up support, as well as more assistance with the local internet connection (Wi-Fi). Teacher P2 said “I’d like training not only before using mobile learning technology in class for the first time, but also after teachers have been using it for a while. Then teachers will know what usage problems they are having and can ask for a solution”.

Theme 4: Problems that arise when using mobile learning technology in primary school

Sub-theme 1: The impact of using mobile learning technology in primary teaching and work time.

Teachers in the interview group indicated that the majority of problems that they faced while using mobile learning technology in teaching were not directly caused by the lesson plans but instead by external factors such as device quality issues or internet connectivity issues. Beyond any issues with the devices, sometimes the school does not have the ability to provide sufficient numbers of teachers to manage and assist the large number of students.

Teacher N1 said, “Since my school is located in a rural area, there are problems with the internet connection, such as slow internet connections. This makes it more difficult and time-consuming to teach students with mobile learning technology. Therefore, I’d like the organisation to follow up, check and repair the devices, and take care of the internet connection in order to improve the effectiveness of teaching”.

Teacher P3 said, “MLT is good for students who have the necessary skills to learn with mobile device such as reading and writing ability. At the same time, a young schoolchild may not have much ability in reading and writing yet. Teachers will have to care for these students more, and that can be time consuming.”

Theme 5: Different teaching approaches

Sub-theme 1: Differences related to the Practicalities of Teaching

Regarding teachers’ perspectives on the practicalities of classroom learning versus teaching mobile learning, most of the interview participants expressed the view that there is not much difference between the two for teachers. Many of the teachers pointed out that when teaching with textbooks, students can see only still pictures while mobile learning technology can include video clips, animated GIFs, etc. Such features can add interest and insight into a lesson, building students’ learning skills and creative thinking. For these reasons teachers tend to use mobile learning technology as supplementary teaching material in order to encourage students and add variety to lessons.

Teacher A1 said, “Students who study from textbooks still benefit from using mobile learning technology, because MLT can help students practice and reinforce the material learned in the textbook. I have used the mobile learning as supplementary teaching material in order to encourage their skills and make studying more interesting. Additionally, regular paper textbooks cannot contain videos clips or other forms of animation. MLT can help students see more details and a give them additional perspective. Therefore, I have used mobile learning technology so that they can see the animated pictures and understand things better. This resource can reduce the time needed to explain something and also save preparation time”.

Teacher A2 said, “On the one hand, teaching with MLT can make learning more interesting. On the other hand, regular classroom learning provides more opportunities for personal contact and personal interaction than MLT”.

Teacher K1 agreed. She said, “I think that mobile learning technology can motivate students and make them more interested than I can alone without MLT. Also students will learn more, beyond their classroom lesson. Moreover, MLT can do many things quickly and conveniently, for example, finding pictures or other materials that help students understand things”.

Teacher P2 also had the following suggestion. “Mobile learning is not too different from regular class learning, but when I use MLT, I need to keep an eye on the students, so that they stay on task. This gives the best results”.

To conclude, most of the teachers preferred teaching with mobile learning technology because it can motivate students’ learning and make learning more fun. Nevertheless, for effective learning, teachers combine both of the teaching methods. Mainly the teachers teach as usual with textbooks, but then they enhance their classes using mobile learning technology as supplementary teaching material.

Sub-theme 2: Differences related to curriculum design

Teachers interviewed from rural areas had various attitudes regarding the differences between designing curricula for regular classes and designing curricula for MLT. Most of the teachers felt that the two process are a little bit different, but some teachers said that they easily adapted traditional curricula

for use in MLT. Some other teachers said that they found designing and preparing curricula for MLT quite complicated.

Teacher A2 said, “Designing the two kinds of curricula is different. Designing a curriculum for mobile learning takes more time than a classroom curriculum, because many of the teachers are older people who are less fluent in the use of technology. Some teachers are themselves learning to use the devices for the first time, just like the students”. Teacher P2 agreed with teacher A2, saying “These two kinds of teaching preparation are different”.

Teacher P1’s feeling was, “The two kinds of preparation are not that different, because I’m able to use most of the old (traditional) curriculum and easily apply it to mobile learning. This point is the same as teacher K1’s, who said, “When I have to design a curriculum or prepare for teaching, I don’t take that much time, because I can use the classroom curriculum and just adapt it when necessary so that it works for mobile learning, too. Since the content of mobile learning is similar to the content of textbooks, I have used mobile learning for additional teaching media. For example, there are many applications that I can easily open to find and download relevant photos, animations, and videos. These work better for students than always looking at nothing but still pictures. Interesting media motivates students to learn more and helps them better understand the lesson content”.

The most salient message from the rural area teachers is that they sorely feel a need for additional training and guidance for using mobile learning technology in class.

Final Thematic Map of School managers' Perspective

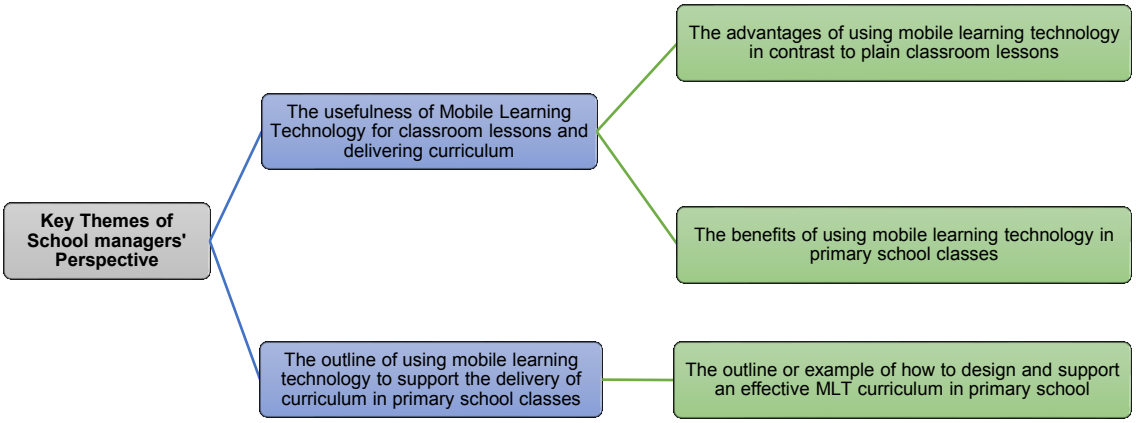

Figure 4.20 Thematic Map of School managers' Perspective

Key Details of School managers' Perspective

Theme 1: The usefulness of Mobile Learning Technology for classroom lessons and delivering curriculum

This theme focused on actual day-to-day experiences using MLT in class and delivering the curriculum through Mobile Learning Technology. The two sub-themes are:

Sub-theme 1: The advantages of using mobile learning technology in contrast to plain classroom lessons.

Sub-theme 2: The benefits of using mobile learning technology in primary school classes.

Theme 2: An outline for using mobile learning technology to support the delivery of curriculum in primary school classes

An outline for using mobile learning technology is a significant key theme. It emerged to help design and support the delivery of curricula in primary school teaching. This theme shows the perspective of each school manager and how they design the curriculum to blend well with and reinforce regular classroom lessons. The single sub-theme of this theme is:

Sub-theme 1: Outlines or examples of how to design and support an effective MLT curriculum in primary schools.

The Perspective of School Managers in Urban Areas

Theme 1: The usefulness of Mobile Learning Technology for classroom lessons and delivering curriculum

Sub-theme 1: The advantages of using mobile learning technology in contrast to plain classroom lessons.

School managers interviewed in urban schools perceived that teaching with mobile learning technologies has a variety of advantages both for day-to-day learning in the classroom and delivery of a comprehensive curriculum in primary school. The majority of school managers highlighted their enthusiasm for delivering curricula with mobile learning technology, because MLT can help introduce new technical knowledge that benefits both teachers' lessons and students' learning.

The school manager interviewed from W1 primary school said during their interviews, "MLT can support, and help students learn new technology. It also takes the quality of education to a higher level and broadens the students' vision. This point is very similar to that of the school manager of W22 School, who said, "With adequate planning and preparation, mobile learning technology will be an asset to the school and help deliver the curriculum in a new way. MLT can be a great resource for teachers who are naturally always keen on finding new tools and methods to encourage and motivate students. As a result, MLT can keep Thai schools competitive with other countries". Furthermore, the school manager of W21 added, "Not only is MLT good for the school and a good vehicle for the curriculum, it's also fairly easy to manage. It can reduce preparation time for teachers. That frees teachers up to spend more time on other tasks, for example taking care of slower students who could use some extra attention".

School manager of M1 School confirmed, "Mobile learning technology can assist in the management of the primary school curriculum. Furthermore, it can provide teachers and students with additional media to build student progress."
Sub-theme 2: The benefits of teaching practice and delivering the curriculum with using mobile learning technology in teaching

Most of the school managers interviewed indicated that MLT aids teachers in the delivery of everyday classroom lessons and it aids students in gaining additional experience using new technology. In particular, teachers have more educational materials at their disposal for teaching their students. An administrator of A1 School stated, “I think mobile learning technology is very useful in the educational system. It can be a great resource for teachers, particularly in schools with limited technology, media, and related learning opportunities. MLT provides students with more learning opportunities. That encourages me, so I am ready to support and invest in setting up Wi-Fi in all areas of the school in order to give students plenty of internet access. I’m also ready to invest in more teaching media resources for our teachers.” This attitude is shared by both school managers of W21 and W22. School manager W21 said, “It’s useful for students to learn new technology which can be done anytime by themselves, both at school and at home. Moreover, teachers can develop their teaching media and curriculum planning in technology literacy by themselves in order to teach more effectively.” School manager of W22 added. “Mobile learning technology is beneficial in that students can learn anywhere, anytime. MLT is useful when the content and lesson plans are well prepared”. Moreover, to deliver effective curriculum, the school manager of M1 School said of MLT, “it will be beneficial, if the school incorporates the mobile learning technology as part of classroom learning. I have separated MLT into two parts. First, teachers use regular textbooks to teach the main lesson contest. Second, if the teachers want students to understand more and if the lesson contents are appropriate to use with mobile learning technology, that’s a good place to adopt MLT. I’m always on the lookout for new ways to bring more kinds of experiences and opportunities to students through using MLT. On the other hand, a school manager of J1 School said, “To be honest, MLT is not very useful at our school, because the devices are trouble to manage and the reliability of the devices is not very good. Until the technology can be made more convenient and reliable, MLT just isn’t a good fit for our school right now. Our school is really large and most of the students are not responsible enough to take good care of the devices. To increase the effectiveness of MLT at our school, I think the number of students per class should be smaller than it is right now. Smaller class sizes

will be good for using mobile learning technology because teachers can supervise and assist the students more easily".

Theme 2: An outline for using mobile learning technology to support the delivery of curriculum in primary school teaching

Sub-theme 1: An outline or example of how to design and support the effective curriculum in primary school

This sub-theme discusses how to plan and effectively design the delivery of a mobile learning technology curriculum in primary school. To this end, most of the school managers interviewed used mobile learning technology as supplementary media in order to provide extra activities and extra practice. They have integrated the two kinds of teaching curriculum: a traditional curriculum and an MLT curriculum. One way they have done this is by setting up MLT Learning Centres, which are somewhat similar to old style language labs. These MLT Learning Centres can be a boon to both teacher and students.

A school manager of A1 School had a good idea regarding the delivery of an MLT curriculum, saying, "When our school has to use mobile learning technology, the first thing that we do is try to support the MLT curriculum as follows; 1. MLT can be a very convenient resource for both teachers and students, particularly when researching some topic. MLT gives students freedom and expands their vision/experience. I encourage teachers to construct a plan for integrating MLT into their lessons and set limits on when MLT will be used so that the devices do not become a distraction at other times.
2. To assist teachers and students, I specifically include MLT in the curriculum. This way, teachers don't have to swap out and lose some other part of the curriculum to make time for MLT.
3. I provide opportunities for teachers to go to various trainings to improve their MLT skills and encourage them to do so. These training opportunities can help teachers develop additional media for their students.
A school manager of M1 School echoed the ideas of the School manager of A1 School. "My school delivers mobile learning curriculum in the form of additional teaching media. We have also set up MLT as extra activities to supplement traditional teaching. Since this school has computer laboratories for students,

they can come to these labs if they want to further explore a lesson or get more practice. School manager provides suggestions for how much time to allot for MLT related work. That's not difficult to arrange. As for assisting the teachers, our school periodically sends representatives from among the teachers to go attend training in mobile learning technology. When those trained representatives return to school, they function as MLT experts who can in turn train and assist the other teachers."

One school manager of J1 School recommended, "For effective delivery of the MLT curriculum, the quality of devices really needs to be better than this. In addition, it would be a good idea to set up MLT learning centres (similar to computer laboratories). These dedicated learning centres can really help ease the school into using MLT."

A school manager of W1 primary school and school two administrators of W21 and W22 suggested that it would make a significant difference if teachers and other staff could be sent for training specifically about MLT.

For example, school manager of W22 school said, "The first thing that the school needs to be sure of before using and delivering an MLT curriculum is that the teachers and other staff who will be working with the devices must have the skills to solve problems themselves. Therefore, it would be best to develop the teachers' skills. Also an expert should be responsible for preparing the contents of the curriculum in order to achieve the objectives".

This point is similar to that of the administrators of W1 school, who said "The important thing when using MLT in the curriculum is that teachers and other staff need to be trained by the organisation in advance, so that they will be knowledgeable about MLT themselves before teaching it to their students. Adequate advance training will lead to effective teaching".

The Perspective of School Manager in Rural Areas

Theme 1: The usefulness of Mobile Learning Technology for classroom lessons and delivering curriculum

Sub-theme 1: The advantages of using mobile learning technology in contrast to plain classroom lessons.

Almost all school managers from rural areas school agreed that MLT provides advantages in primary school both for classroom teaching and for delivery of curriculum. Most of the school managers said that they have utilised mobile learning technology as a way to deliver supplementary teaching media, because this encourages students to learn and assists teachers in their work.

A school manager of N1 School spoke of the advantages of delivering curriculum by mobile learning technology, saying “It can save teachers time, lightening their heavy workloads a bit. MLT can help teachers prepare documents and other materials to teach. It can also reduce the cost of documents by using paperless distribution. For example in science classes, students learn about the growth of plants. Instead of preparing related pictures to show students, teachers can just open a time-lapse video clip of plant growth using MLT to show to students. The students can see the actual plant growth. This is a good capability provided by MLT, and it makes a learning fun”. School manager of B1 School said, “MLT really helps in the delivery of curriculum, as long as teachers have the skills necessary to use the relevant technology. Our teachers have used mobile learning technology as supplementary teaching media both for in the classroom and outside the classroom. That’s convenient, and it adds to students’ enjoyment of the learning process.”

S1 School manager also supported the delivery of mobile learning technology curriculum, saying, “It can encourage students to reach their learning goals and can also support teachers in their role”. Nevertheless, some school managers also reflected on some disadvantages, such as the sometimes unreliable internet connections due to the rural location of the school. One S1 School manager came to the conclusion that “In my opinion, the implementation of a mobile learning technology curriculum is not a worthwhile investment. At present, various other technologies are used more than mobile learning

technology, because the school is located in a rural area with poor internet connections and an environment not well suited to MLT".

Sub-theme 2: The benefits of using Mobile Learning Technology for classroom teaching and curriculum delivery

When asked about the benefits of using Mobile Learning Technology for classroom teaching and curriculum delivery, interviewed school managers pointed out both some benefits and some drawbacks. Among the benefits mentioned were a reduction in teachers' work related tasks and an increase in time available for teaching preparation or other teaching activities. MLT not only provides teachers with additional teaching tools but also provides students with additional learning media. Students also tend to be more interested, excited and motivated in response to mobile learning technology.

School manager of B1 School revealed that "Delivering mobile learning technology curriculum can help teachers in terms of reducing their work. Also, teachers can have more time to prepare other activities for students. This makes students want to learn more, keeps them interested, and increases attentiveness to learning". School executives of S1 School also stated that "teachers have additional media available that keeps students excited and more interested in learning".

School manager of N1 School suggested that "delivering mobile learning technology curriculum would be more effective, if there were a better internet connection, because our school is located in a remote area. This makes it difficult for the school to manage mobile learning technology". Moreover, school managers of both S1 School and W3 School expressed a shared view that teaching with mobile learning technology is not particularly suitable for younger students because they are too young to comprehend and use the technology.

Theme 2: An outline for using mobile learning technology to support the delivery of curriculum in primary school teaching

Sub-theme 1: An outline or example of how to design and support the effective curriculum in primary school

During their interviews, school managers shared various aspects of how they designed and supported effective MLT curriculums in their primary schools. First, the majority of school managers highlighted that before designing their mobile learning curriculum, they planned in advance, exploring teachers' readiness and considering the content material. The most common pattern among administrators at the various schools is to merge both the traditional curriculum and mobile learning curriculum by setting up teaching with mobile learning technology as additional media or as a learning centre.

School manager of B1 School brought up interesting points about curriculum design, saying, "The key to supporting the curriculum is to make sure that all teachers have adequate knowledge and skills necessary to use mobile learning technology in their teaching. First, everyone involved should themselves plan ahead, before the mobile learning curriculum is deployed.

Secondly, the various curriculum contents have to be considered for their suitability for use in mobile learning technology.

Lastly, the most important thing is teachers have to be ready to use MLT in their teaching. I find it useful to encourage teachers by sending them to training and preparing in order to improve their skills before teaching with mobile learning technology. Furthermore, school admin must follow-up with, manage, and support all teachers. This leads to an effective teaching curriculum and can improve education quality". These points were similar to those of a school manager of S1 School, who stated "To deliver and support the curriculum, I have to plan before using it, by exploring teachers' readiness in the use of mobile learning technology for teaching. If they are not ready and we aim to achieve curriculum objectives in the effective use of mobile learning technology, I will encourage teachers and improve their relevant skills by sending them to training with the MLT organisation, so as to maximize their effectiveness in teaching".

Additionally, besides planning and exploring, a school manager of N1 School explained, “I manage the process by arranging for teachers who have advanced skills in teaching by computer and mobile learning technology to pass on their knowledge by training the other teachers. Moreover, I analyse the nature of the content and determine which contents are suitable for teaching by mobile learning technology by using it as additional teaching media. This makes teaching by mobile learning technology more effective”.

The viewpoints of the administrators of N1 School are the same as those of school manager of W3 School: “I will manage things by setting up a learning centre for mobile learning technology as additional media teaching or extra hours. Furthermore, I send teachers who will be using mobile learning technology for training before they teach with it”.

4.2.3 Discussion

The aims of this study were to investigate the requirements for mobile learning technology use for teaching and delivering curriculum. This study highlighted key issues that teachers and school managers are currently facing with mobile learning technology usage; in order to develop an understanding of MLT needs to be incorporated in primary school teaching establishments.

Prior to using the SSM techniques, differences in perspectives were compared and discussed between urban and rural areas. These are summarised in Table 4.16 shows Teachers' Perspective. Table 4.17 illustrates School managers' perspective.

This study's results describing teachers' perspectives and school managers' perspectives, from both urban areas and rural areas, are discussed by utilising Soft System Methodology techniques (SSM). Rich Picture, Root Definitions, and CATWOE analysis are used to illustrate the results further. The research study can contribute to developing a decision support model of mobile learning technology to guide in planning and delivering curriculum for using mobile learning technologies for teaching.

Table 4.16 The perspective of teachers between urban and rural areas in teaching with mobile learning technology

Statements of Theme	Statements of Subtheme	Urban areas	Rural areas
Theme 1: The background of using Mobile Learning Technology	**Sub-theme 1:** Subjects taught with mobile learning technology	**- Thai language** **- Mathematics** **- English Language** **- Sciences** - History - Social - Health education	**- Thai language** **- Mathematics** **- English Language** **- Sciences**
	Sub-theme 2: Current features/ Applications used for teaching with mobile learning technology.	**- Games (Used as teaching aids)** - **Practice exercise** - Reading contents - Quizzes	**- Games (can encourage and motivate students' learning)** **- Practice exercise (Suitable for Mathematics)** - Quizzes - Picture - Reading - Video/Media
	Sub-theme 3: Suitability of features/applications for teaching with mobile learning technology.	- Appropriate in primary school teaching as "**additional/supportive teaching"** that can help to **motivate student.**	Features/applications suitable for subjects and contents are related to textbooks. - Can help and **motivate students** and making **studying more fun.**

Table 4.16 The perspective of teachers between urban and rural areas in teaching with mobile learning technology (Cont.)

Statements of Theme	Statements of Subtheme	Urban areas	Rural areas
Theme 2: The benefits of mobile learning technology for teaching	**Sub-theme 1**: The advantages of using mobile learning technology in teaching	- The use of mobile learning technology in teaching can develop and encourage students' learning in terms of the students getting more experience, more skills, and more practice that is individual. - Students will learn about new technologies, ease of understanding and convenience. - Can aid teacher teaching in terms of reducing the workload of teachers (as having **Teacher Assistant).** **-**can help motivate students to learn more. - Good for providing practice, and can help students had better remember material.	- can stimulate and develop students' thinking, motivate students to more practice, can review material by themselves and they are more active in studying. - They can quickly search for contents that they want to know more. - For teachers MLT can reduce preparation time.
	Sub-theme 2: The effectiveness of using mobile learning technology in teaching.	- will be effective when used as **additional teaching media.** - Easier to understand, can see the actual movement. - use to support teaching.	- Applied teaching and used MLT as supplementary teaching media.

Table 4.16 The perspective of teachers between urban and rural areas in teaching with mobile learning technology (Cont.)

Statements of Theme	Statements of Subtheme	Urban areas	Rural areas
Theme 3: Mobile learning technology requirements	**Sub-theme 1:** The need for training before using mobile learning technology in primary school teaching.	- Training is required (need an organisation or school to train them thoroughly before using mobile learning technology in primary school teaching). - More Guidance/documentation - Additional Features/Applications	- Need additional Training in MLT before using MLT in order to maximise the effectiveness of the MLT teaching for students. - **need additional funding to set up infrastructure and need support staff** to be made available to improve the use of MLT when teaching.
Theme 4: Problematic situations when using mobile learning technology in primary school	**Sub-theme 1:** The impact of using mobile learning technology in primary school and during work time.	- External Factor (such as quality of device, unreliable internet connection, that lead to difficult to control and waste time).	- External Factor such as quality of device, internet connectivity issues. - **Readiness of teachers and school** in terms of school does not have the ability to provide sufficient numbers of teachers to manage and assist the large number of students.
Theme 5: Differences between using MLT and more traditional methods	**Sub-theme 1:** Differences related to the Practicalities of Teaching	- There are a few difference (use as additional teaching or supportive teaching)	- There is not much difference in teaching practice (use MLT as supplementary teaching material in order to encourage students' skills).

Table 4.16 The perspective of teachers between urban and rural areas in teaching with mobile learning technology (Cont.)

Statements of Theme	Statements of Subtheme	Urban areas	Rural areas
	Sub-theme 2: Differences related to curriculum design	- Different attitudes are in curriculum design. 1. More difficult to prepare and design curriculum and lesson plan for mobile learning because of external factor. 2. Some teachers feel designing curriculum and lesson plans that more comfortable because they can use feature from application of mobile learning to teach.	- A little bit different (because they easily applied and designed curriculum from traditional teaching to mobile learning teaching).

Table 4.17 The perspective of school managers between urban and rural areas in teaching with mobile learning technology

Statements of Theme	Statements of Subtheme	Urban areas	Rural areas
Theme 1: The usefulness of Mobile Learning Technology for classroom lessons and delivering curriculum	**Sub-theme 1:** The advantages of using mobile learning technology in contrast to plain classroom lessons.	- Can help introduce new technical knowledge as an additional media that benefits both teachers' lessons and students' learning. - improves the **education quality** **- Broadens the students' vision** - **can be competitive** with other countries.	- Most school managers have delivered MLT curriculum as a way to deliver supplementary teaching media because this encourages students to learn and assist teachers' teaching. - Can **save preparation time, lightening their heavy workloads a bit.** - **Reduce the cost of documents.**
	Sub-theme 2: The benefits of using mobile learning technology in primary school classes.	- Useful in terms of enhancing students' learning. - Aids students in gaining additional experiences using new technology. - Teachers have **educational materials that is more support teaching.** **- more learning opportunities** **- MLT** can be used to learn **everywhere and anytime.**	- Reduction in teachers' work - **Increase in time available for teaching preparation and other teaching activities time.** - MLT is useful to **improve** students' learning. - Teachers have **more teaching tools** and students have **learning media.** - Students tend to be more **interested, excited, and motivated.**

Table 4.17 The perspective of school managers between urban and rural areas in teaching with mobile learning technology (Cont.)

Statements of Theme	Statements of Subtheme	Urban areas	Rural areas
Theme 2: The outline of using mobile learning technology to support the delivery of curriculum in primary school classes	**Sub-theme 1:** The outline or example of how to design and support the effective curriculum in primary school	- School managers used mobile learning technology as supplementary media in order to provide extra activities and extra practice. - They have **integrated** the two kinds of teaching curriculum: a traditional curriculum and MLT curriculum. - They are setting up **MLT learning centres.**	- When they have to design the curriculum, they have to plan, exploring teacher's readiness, and consider the contents material. - They **merge** both the traditional curriculum and mobile learning curriculum by setting up teaching with MLT as **additional media or as a learning centre.**

In this research, teachers and school managers reflected on their background in the use of mobile learning technology, which was to be used to support teaching and delivering the curriculum.

In conclusion, this section of the study presents the perspectives of teachers and school managers on the challenges of the use of mobile learning technology for teaching and for delivering the curriculum. The results of this section can be summarised as follows:

1. Relating to the background of using mobile learning technology, since each student has a widely varying ability level, the suitable features/applications of mobile technology for teaching that teachers can use as an additional teaching aid in the classroom and match them are games, practice exercise, reading, quizzes, and video clip/media. (Which can motivate and make a learning fun for younger students).
2. Teachers have used mobile learning technology in the form of supplementary material or teaching aids in the classroom. This was helpful for motivating students' learning and enhancing learning. In addition, MLT can save preparation time for teachers. In the case of school managers, they have

integrated the traditional curriculum and the MLT curriculum, setting up teaching with MLT as additional media or as a learning centre.

3. The benefits of the use of mobile technology for teaching that teachers and school managers express are that MLT can stimulate and develop students' thinking, encourage and motivate students' learning. Can aid teacher for teaching in terms of reducing the workload of teachers (as having Teacher Assistant). Regarding teachers' teaching can also be a convenience to teacher for teaching, reducing preparation time and teachers have more teaching tools and student have learning media and more learning opportunities.

4. Before using MLT, training is required in order to maximise the effectiveness of the MLT teaching for students, more guidance/documentation and need addition funding to set up infrastructure and need support staff to be made available to improve the use of MLT when teaching.

The results of the semi-structured interviews of this research are similar to the teachers' interviews results of Lu et al. (2014) who stated that the application of mobile learning technology as a learning tool can support teaching. MLT can enhance the activities of the students' group and it accommodated learning capabilities. In addition, all the teachers in the Lu et al. (2014) study felt that MLT can save their time on demonstration, increase student engagement and students are more interested in learning. Teachers felt that this is useful for them, in particular, students who are at lower levels of learning because their students were excited to discover new instructional methods and were willing try to use MLT. Although using MLT can support teachers and increase student engagement, Anshari et al. (2017) argued that using MLT in the traditional classroom also has a disadvantage; for example, it may contribute to distraction, lacking in handwriting skills, and be reducing face-to-face interaction. Nevertheless, teachers and school managers in this research believed that technological resources are part of important elements of the success of the curriculum delivery.

Ktoridou and Eteokleous (2005) indicated two ways used for approaching mobile learning technology integration, using MLT as supportive tools, and using MLT as instructional tools. Regarding using MLT as a supportive tool, it means using mobile learning technology to support learning in order to

communicate with teachers and students in searching information and other features/applications. Also using MLT as an instructional tool, it means that teachers provide appropriate tool choice and other materials for students' learning.

These research findings are related to the use of MLT for teaching identified by teachers and school managers. The MLT can be used in primary schools in order to support effective use of technology for teaching and delivery. Most of these teachers used traditional textbook and mobile learning technology platforms to support their teaching. In terms of use of MLT as a supportive tool, for example, teachers use MLT to support their teaching such as searching video clips or time-lapse videos to show and explain a concept of plant growth. Relating to students, they can revise easily by themselves (Anshari et al., 2017). In terms of using MLT as an instructional tool, for instance, students need to review mathematical skills; teachers can provide games or exercises to their students. Furthermore, in order to effectively use MLT, in this research MLT was used as a supplementary learning, blending or integrating MLT into traditional classroom teaching which provided opportunities to students for practising skills.

In accordance with the research results, teachers and school managers have a suggestion that they use MLT as a supportive teaching that we can call "Blended learning". The blended learning can be defined as combining the advantages of different types of learning environment between traditional classroom teaching and mobile learning technology and providing the ease of use and effectively integrated technology in the classroom. This learning model is used to certify an effective learning environment for pupils and effective teaching environment for teachers (Bonk & Graham, 2012; Köse, 2010). Teachers' perception in the study of Yusof et al. (2011) related to blended learning noted that the use of ICT or mobile learning technology will provide the opportunity for enhancing their technology usage skills in teaching that can motivate students to learn, can enhance attention and increase engagement. Moreover, the use of mobile learning technology as blended learning in the

classroom can assist teachers to save the use of paper and can repeat the activities on MLT.

Additionally, related to the interviews results, there are some interesting points that the rural teachers and schools having competence in the use of technology for teaching had better technology usage than urban teachers. It appears that the rural teachers just have a chance to engage with this new technology due to their remote area and students have more opportunity in learning. The study of Cox et al. (1988) concerning learning styles between rural and urban students in India, found that rural students concentrate and engage in learning more than urban students. While urban teachers or schools have been familiar in using mobile learning for teaching and schools, and have an infrastructure that can afford to provide technology for their students such as internet and computers better than rural areas. Therefore, this is a reason why the rural students may be more interested and use technology better than urban students do.

Finally, overall from the results of both the pilot study questionnaire (quantitative) and semi-structured interviews (qualitative) it can be concluded that: Firstly, teachers and school managers need an appropriate decision support model of mobile learning technology in order to guide teachers in teaching with MLT and to guide school managers in designing the MLT curriculum. Similarly, Ally et al. (2014) and Oz (2015) have stated that guidance and teacher training are significant and necessary for teachers in the use of mobile learning technology in terms of designing lessons, delivering the curriculum and designing informal learning in the classroom. These are assisting teachers to prepare for the use of MLT and promoting school managers to deliver the MLT curriculum effectively. For example, the use of MLT in the classroom to access teaching materials, providing convenience and more teaching knowledge sources (Anshari et al*.,* 2017). Secondly, most teachers prefer to use MLT as a supportive tool and an instructional tool on their teaching that can encourage students to engage and be interested in learning. Finally, school managers have delivered the MLT curriculum by planning the use of MLT as supplementary learning, by blending the MLT

curriculum into the traditional curriculum. Teachers and school managers have delivered MLT as a supplementary tool. These results can be supported by teachers' perceptions about mobile assisted language learning (MALL), which revealed that the majority of teachers have positive attitudes towards the use of mobile learning technology. Their interview results expressed that mobile learning technologies can be used as a supplementary tool to language learning and teaching. They trusted that using MLT supplement in the classroom can save preparation time, enhance successful language learning and increase students' interest (Oz, 2015). Also, in a survey of teachers' perception of the use of mobile phones in the classroom an investigation by O'Bannon and Thomas (2015) showed that almost half of the teachers supported that using mobile technology for teaching in the classroom is helpful for them in terms of integration with the traditional classroom. This indicates that most teachers use MLT in teaching and learning as a supportive tool and delivering MLT as a supplementary learning can provide effective teaching and can create attractive teaching. Nevertheless, there are some challenges of using MLT in the classroom one of which is that it is a distraction. For instance, MLT can reduce the quality of teaching face-to-face communication, and result in lacking in handwriting skills. For avoiding any distraction caused by the use of MLT within the classroom environment, teachers and school managers have to set up MLT as a Learning Centre or set reasonable rules of using MLT in the classroom (Anshari et al*.,* 2017).

4.3 Summary

The results of teachers' perspectives and school managers' perspectives will be used to generate a decision support model guide for planning mobile learning technology usage through Soft System Methodology, which is shown in Chapter 5.

Chapter 5 Soft System Methodology used for development the Decision Support Model

Introduction to Chapter

This chapter presents the use of Soft System Methodology to design the decision support model of mobile technology for teaching. The decision support model is given. Then we will highlight and discuss the decision support model of mobile technology for teaching. Lastly, the further evaluation will be provided.

5.1 Soft System Methodology Process

The seven stages of Soft System Methodology (SSM) are discussed to address problems encountered by and mentioned by the participants, in order to generate the decision support model of mobile learning technology. This section presents the themes arising from thematic analysis of the semi-structured interviews in order to understand the problems encountered and to try to resolve them. Hence, in this section the SSM will be used to apply and will be used to generate the decision support model guide for planning the use of mobile learning technology in primary schools in Thailand, via the seven stages of SSM.

SSM Stage 1: Find out and consider unstructured problem situation

This stage is used to find out and consider the problem situation from the quantitative results in order to obtain a requirement of teachers' needs and school managers' needs for the use of mobile learning technology for teaching and delivering in primary school. SSM was used for focusing on gaining what is appropriate and effective to develop the decision support model of mobile learning technology. Therefore, in this stage, the quantitative results are discussed to find the problem situations of the system.

The main problem situation of this study is that the teachers require guidance and training because they lack training, guiding and support from the organisations related to the education system. School managers need a decision support model to guide and support them to deliver the mobile learning

technology curriculum effectively. At the next stage, the problems are investigated and summarised in a Rich Pictures.

SSM Stage 2: Expressing Problem Situation

The SSM techniques in stage 2 investigate participants' ideas relating to the problem situation in order to rank the problematic situations related to the use of mobile learning technology in teaching. Regarding the problem situation from stage 1, the Rich pictures will be used to outline the main system that represents the main problem of the use of mobile learning technology system in primary school. Therefore, the problem situation is summarised and exposed through the "Rich Pictures".

Rich Pictures

The rich pictures will be generated as a collaborative effort of two areas (Urban and rural areas) and both teachers' perspective and school managers' perspective of questionnaire and semi-structured interviews to recognise the relationships between different elements of the use of mobile learning technology in delivering the curriculum. Therefore, the Rich Pictures should be used with the descriptive analysis of the questionnaire results and thematic analysis of the outcomes from the semi-structured interviews as shown in figure 1-7 below. Figure 5.1 shows the rich picture of the Requirements of Mobile Learning Technology which is from the questionnaire results. Figures 5.2 to Figure 5.7 show the rich pictures which were created from the analysis of qualitative data through semi – structured interviews.

Principally, the Rich Picture develops parallel perspectives of teachers and school managers that are used to represent the ideas and requirements of a situation in pictures.

Note: Figure 5.4, the Rich Picture was created by integrating Teachers' Perspective between urban areas and rural areas. Figure 5.7, the Rich Picture was recreated by integrating School managers' Perspective between urban areas and rural areas.

At the next stage the problems are investigated, and Root definitions of the systems are created and CATWOE criteria will be used to analyse and create the definition of the relevant systems.

Rich Picture of quantitative data (The requirement of using MLT)

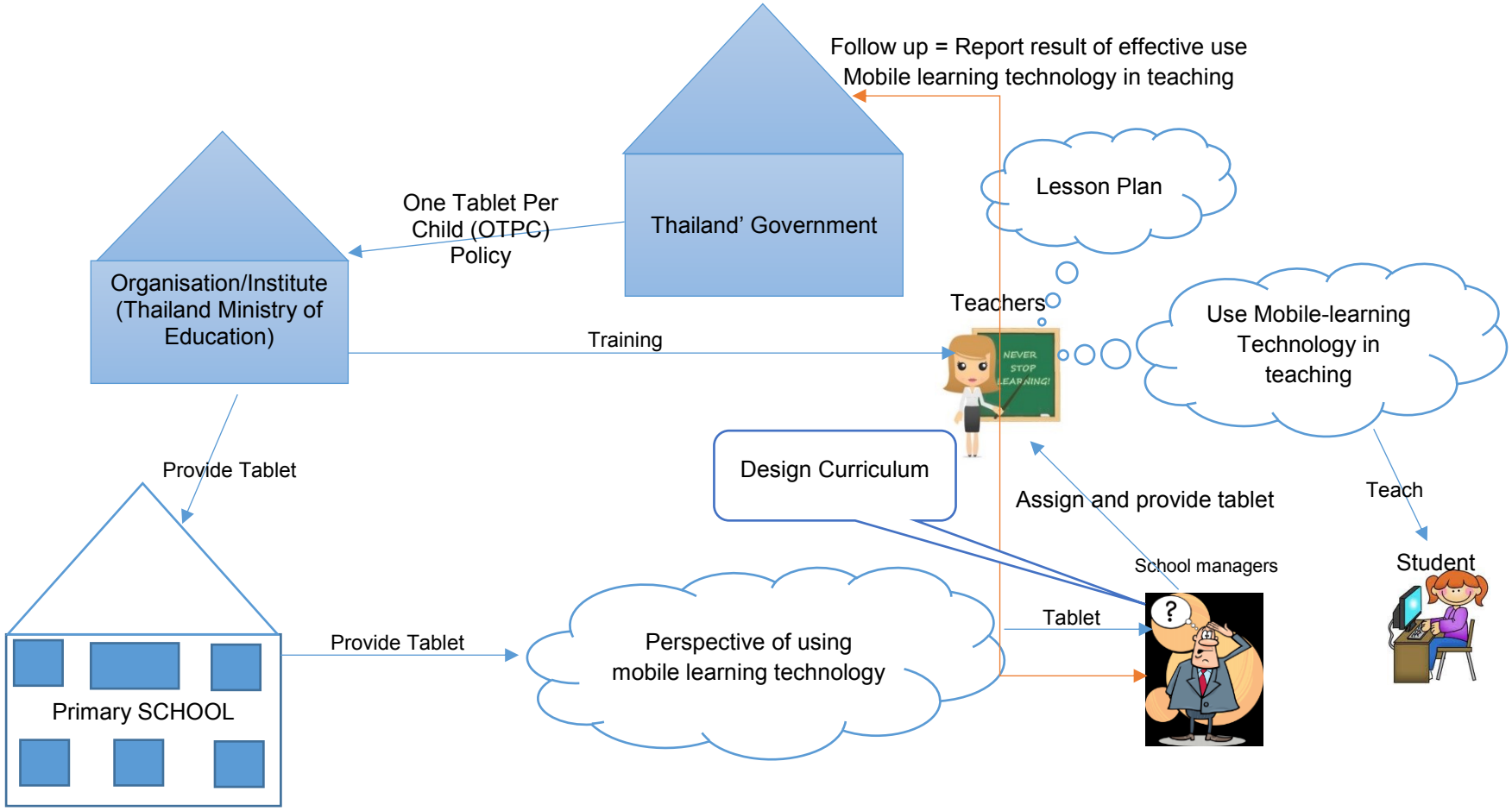

Figure 5.1 Rich Picture of quantitative data (The requirement of using MLT)

Rich Picture of Teachers' Perspective in Urban Area (Recreated from results of semi-structured interviews)

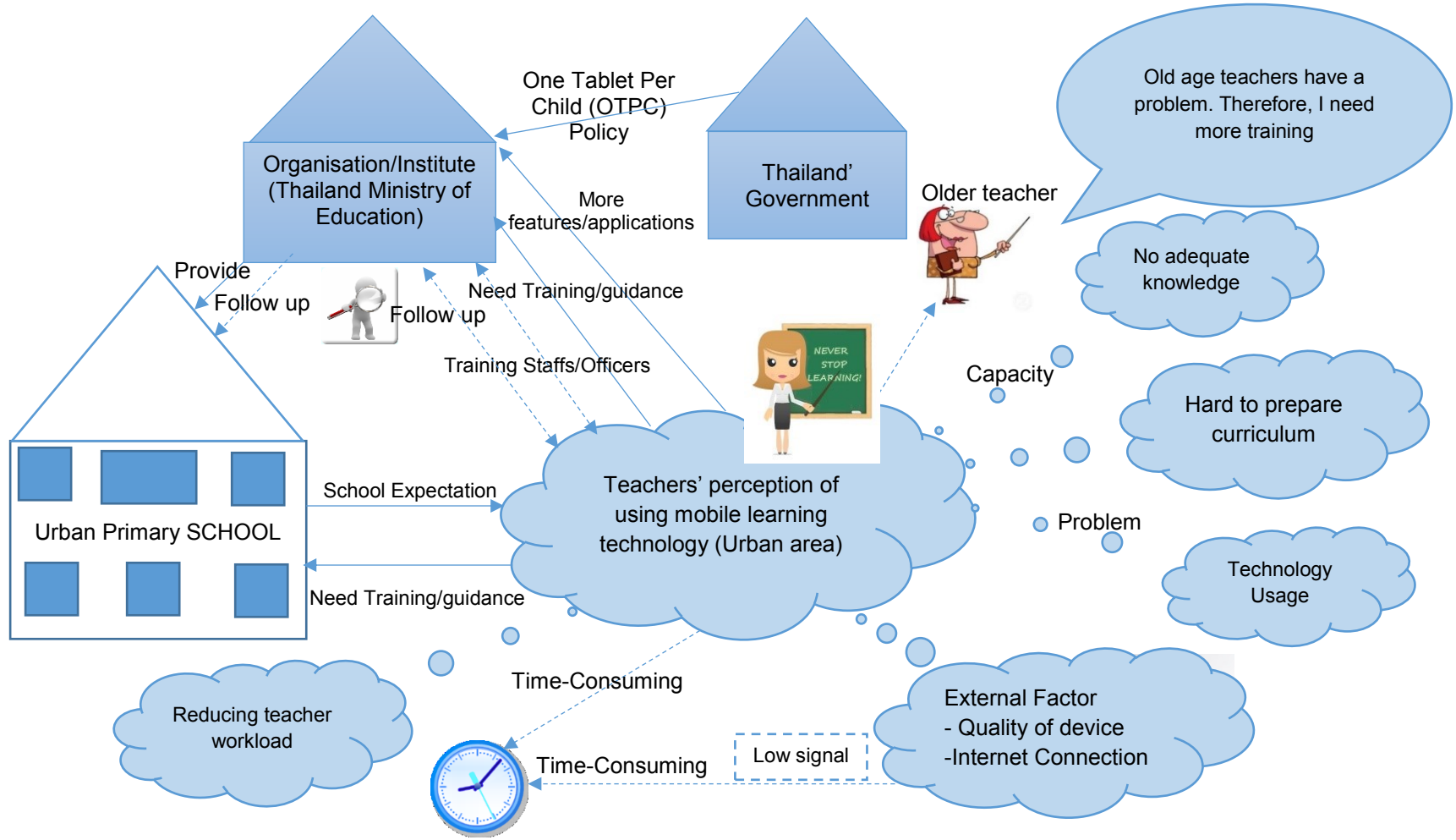

Figure 5.2 Rich Picture of Teachers' Perspective in Urban Area (Recreated from results of semi-structured interviews)

Note: **Blue** colour represent urban areas

Rich Picture of Teachers' Perspective in Rural Area (Recreated from results of semi-structured interviews)

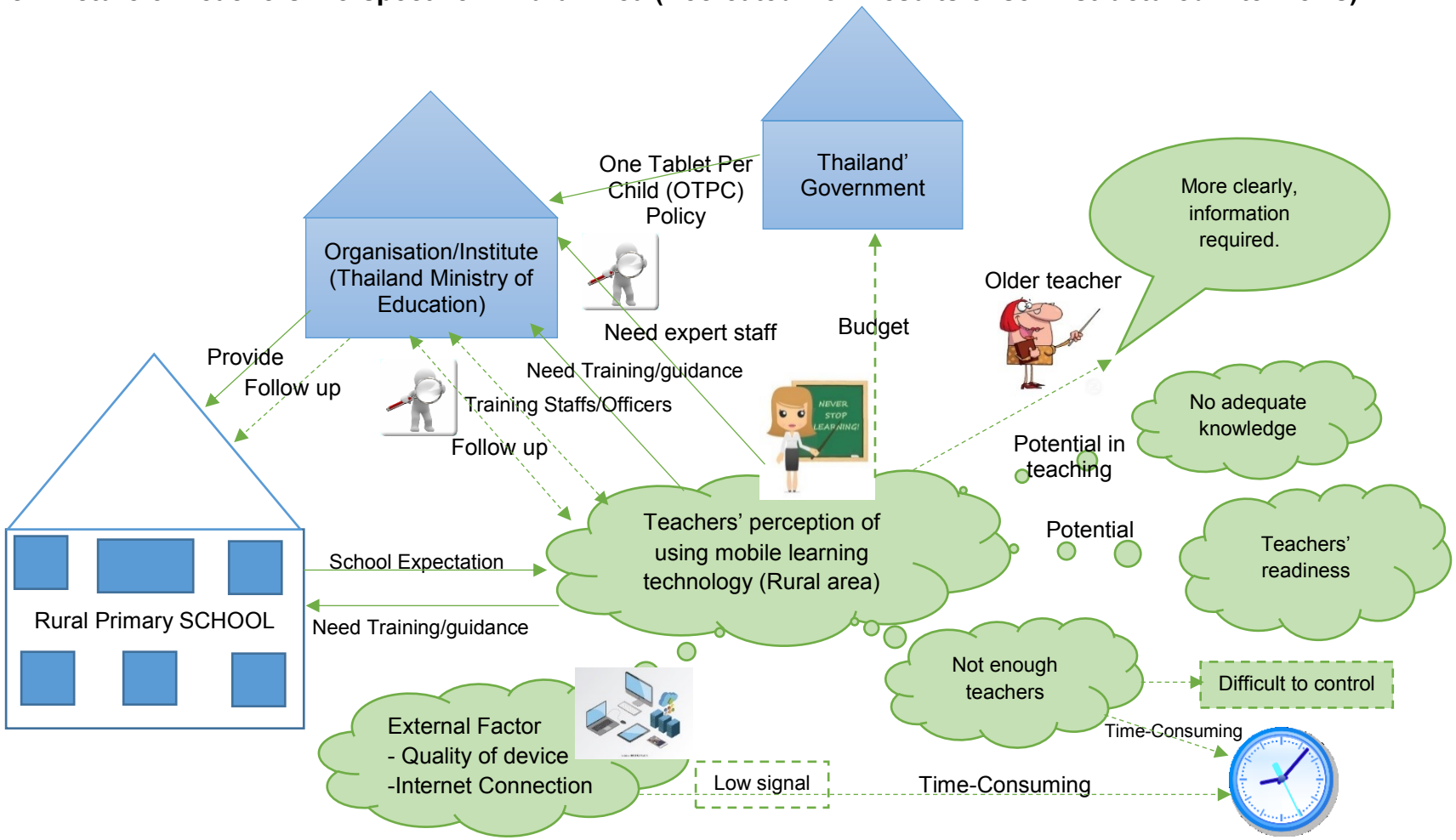

Figure 5.3 Rich Picture of Teachers' Perspective in Rural Area (Recreated from results of semi-structured interviews)

Note: **Green** colour represent rural areas

The Rich Pictures are integrated teachers' perspective between Urban and Rural Areas

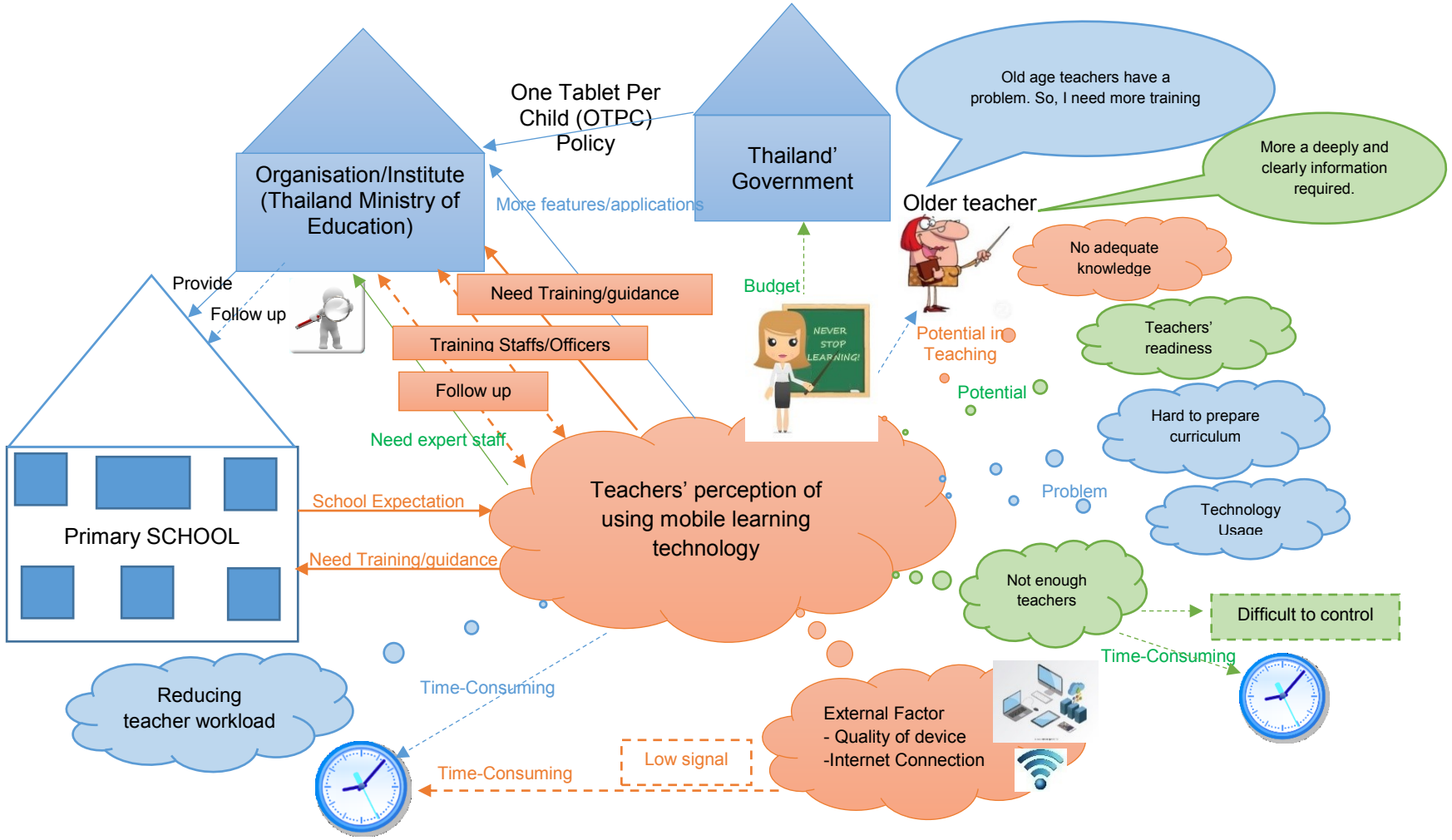

Figure 5.4 This Rich Pictures are integrated teachers' perspective between Urban and Rural Areas

Note: **Blue** colour represent urban areas, **Green** colour represent rural areas, and **Orange** colour represent urban and rural areas

Rich Picture of School Managers' Perspective in Urban Area (Recreated from results of semi-structured interviews)

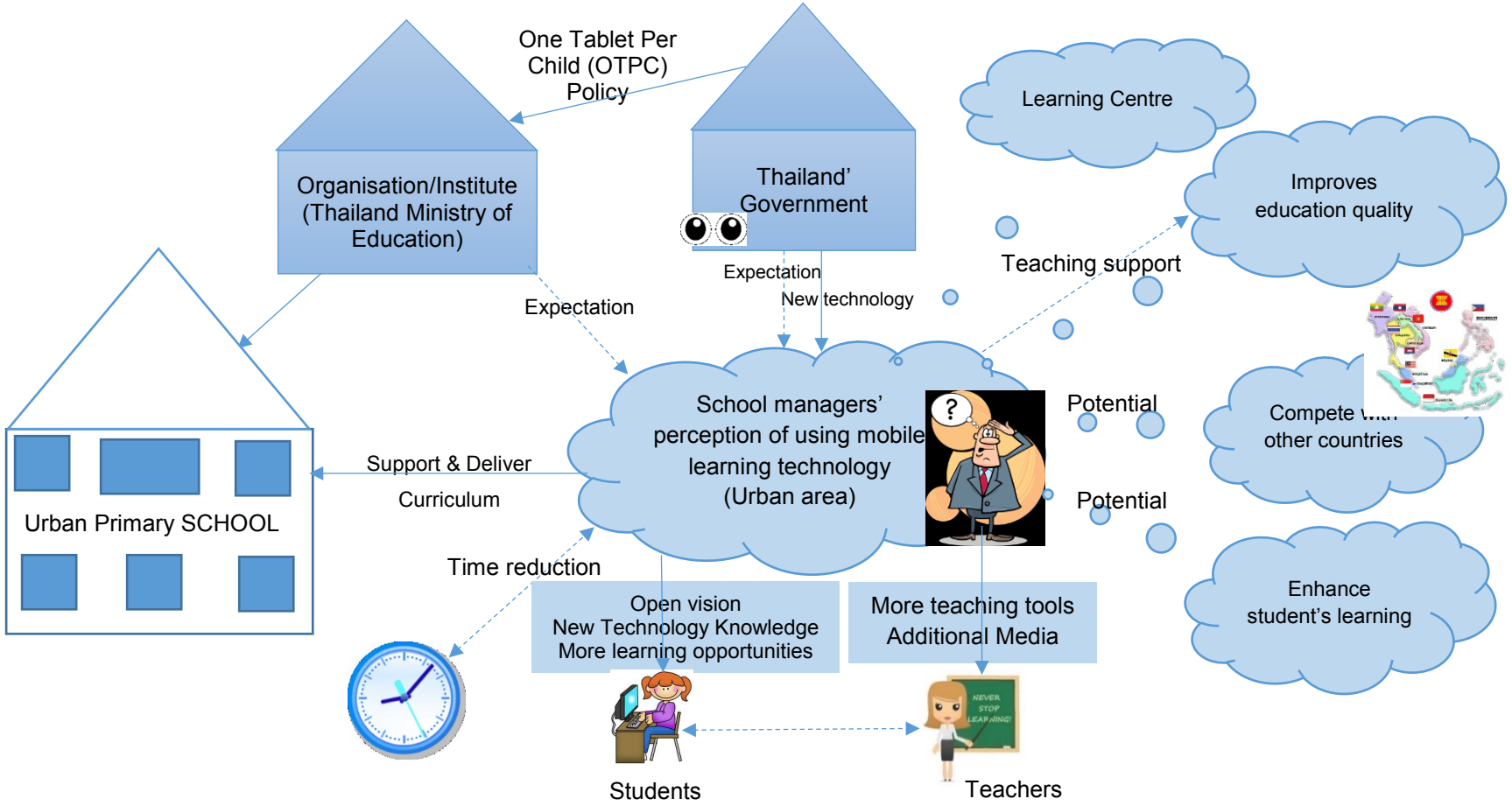

Figure 5.5 Rich Picture of School Managers' Perspective in Urban Area (Recreated from results of semi-structured interviews)

Note: **Blue** colour represent urban areas

Rich Picture of School Managers' Perspective in Rural Area (Recreated from results of semi-structured interviews)

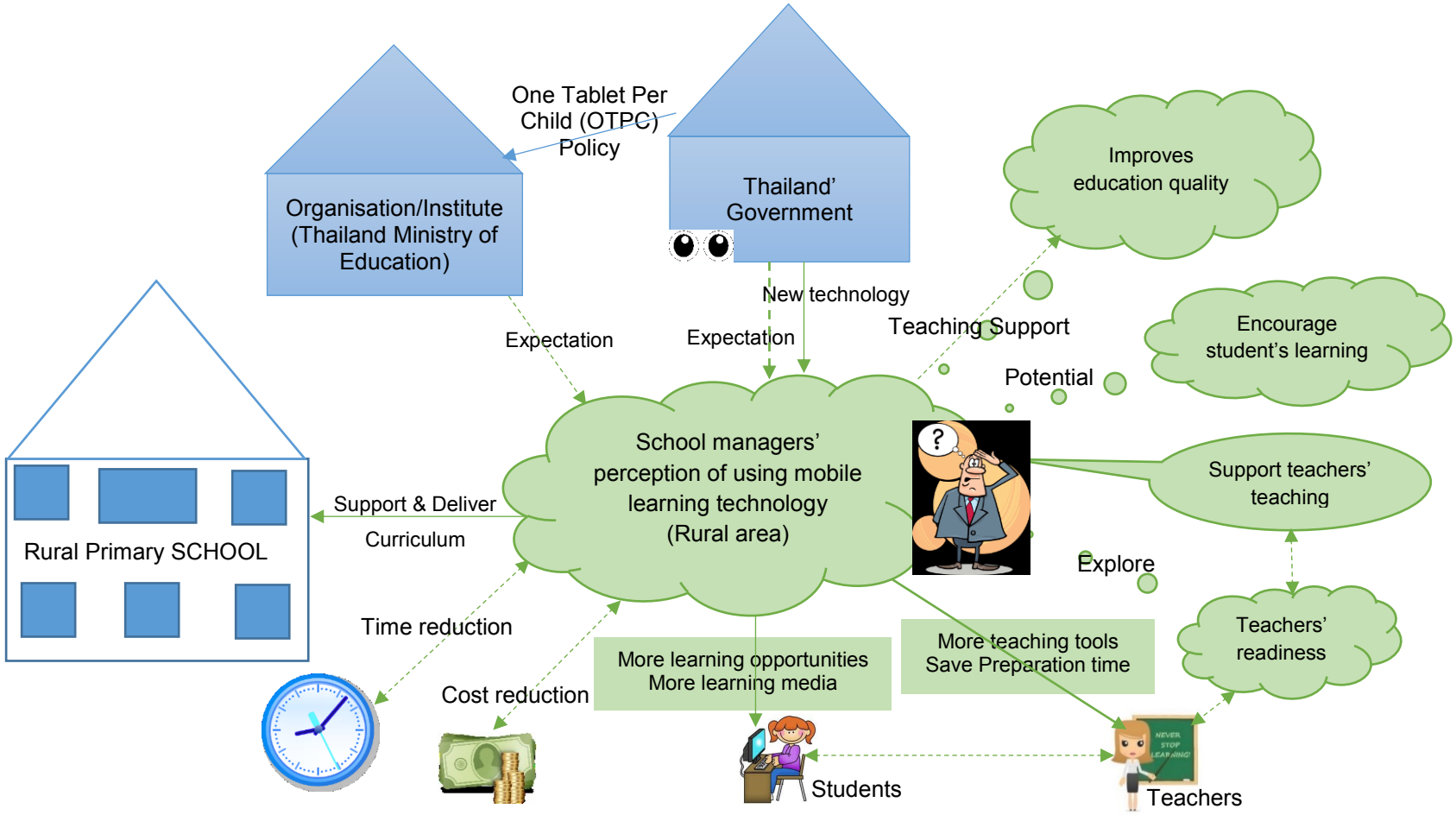

Figure 5.6 Rich Picture of School Managers' Perspective in Rural Area (Recreated from results of semi-structured interviews)

Note: **Green** colour represent rural areas

The Rich Pictures are integrated School Managers' perspective between Urban and Rural Areas

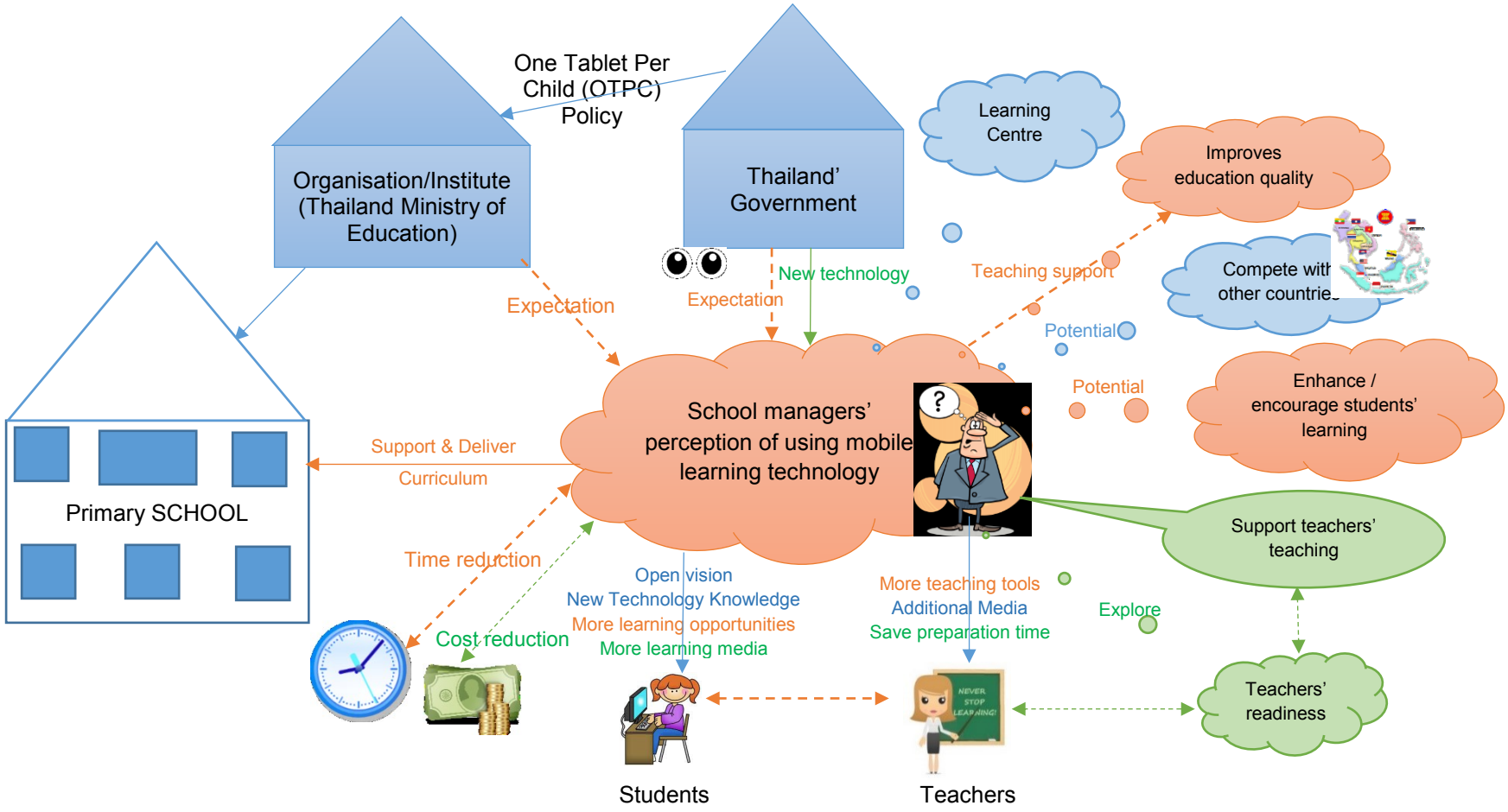

Figure 5.7 The Rich Pictures are integrated School Managers' perspective between Urban and Rural Areas

Note: **Blue** colour represent urban areas, **Green** colour represent rural areas, and **Orange** colour represent urban and rural areas

SSM Stage 3: Root definitions of Relevant Systems

This SSM stage is used to move the thinking of participants about the problem situations, concerning the use of mobile learning technology in teaching and delivering curriculum through the 'Root Definitions' of relevant systems. The six elements of analysis namely CATWOE analysis can be used to create the definition of the relevant systems.

Root definition and CATWOE analysis before data collection

Root definition:

Thailand' government – owned and operated system to improve primary education system by providing new technology, in order to improve primary education quality and develop education opportunities.

CATWOE Analysis

Between the creations of rich pictures, the six elements of CATWOE analysis created from the quantitative data through questionnaire based on requirements are presented in the table below:

Table 5.1 CATWOE Analysis

Key elements of theoretical		**Key elements applied in this study**
C: Customers	Who are systems beneficiaries?	Teachers, school managers, and students
A: Actors	Who transform inputs to outputs?	Thailand' government, Thailand Ministry of Education, school managers and teachers
T: Transformation process	From inputs into outputs	The use of mobile technology in teaching to deliver primary education.

Table 5.1 CATWOE Analysis (Cont.)

Key elements of theoretical		**Key elements applied in this study**
W: Weltanschauung	The relevant world view	The belief that providing suitable technology is a good way of improving the education quality.
O: Owners	Those who control the systems	Thailand' government and Thailand Ministry of Education
E: Environment Constraints	Environmental constraints taken as given and which need to be considered	Technology, quality expectations

Root definition and CATWOE analysis (Recreated from results of semi-structured interviews)

Root definitions used in stage 3 define the relevant systems purpose, and are stimulated through using CATWOE criteria.

Root definition of school managers and teachers:

A system owned by Thailand's education ministry, who operate primary schools, wants to improve delivery of education curriculum and compete with Asian countries at primary school level by introducing mobile learning technology in order to help teaching, improve education quality and expand education opportunities throughout the country.

CATWOE Analysis

The rich picture created both groups and locations distributed on the six criteria of CATWOE analysis. Checkland and Scholes (1990) stated that CATWOE criteria could be used to analyse the system elements.

The CATWOE analysis for both of school managers and teachers is as follows:

Table 5.2 CATWOE Analysis of School Managers

Key elements of theoretical		**Key elements applied in this study**
C: Customers	Who are systems beneficiaries?	Primary schools, school managers, teachers and students
A: Actors	Who transform inputs to outputs?	Thailand' government, Organisation/Institute (Thailand Ministry of Education), Primary school and school managers

Table 5.2 CATWOE Analysis of School Managers (Cont.)

Key elements of theoretical		Key elements applied in this study
T: Transformation process	From inputs into outputs	To use technology, knowledge and management together with details of government policy to prepare curriculum designs of using mobile learning technology for teaching in primary school.
W: Weltanschauung	The relevant world view	To achieve the use of mobile technology in teaching, teachers need a good understanding of the technology usage for teaching that is required.
O: Owners	Those who control the systems	Thailand' government and Thailand Ministry of Education)
E: Environment Constraints	Environmental constraints taken as given and which need to be considered	Competitive, technology, cost and time critical, budgets, and quality education expectation

Table 5.3 CATWOE Analysis of teachers

Key elements of theoretical		Key elements applied in this study
C: Customers	Who are systems beneficiaries?	School managers, teachers and students
A: Actors	Who transform inputs to outputs?	Thailand' government and Organisation/Institute (Thailand Ministry of Education), Primary school, school managers and teachers
T: Transformation process	From inputs into outputs	To use technology knowledge, skills and experience to prepare teaching methods and curriculum designs that deliver the most appropriate technology teaching procedure for using mobile learning technology in teaching.
W: Weltanschauung	The relevant world view	The teachers may have less technology knowledge and Thailand' government/Organisation /Institute (Thailand Ministry of Education) have not provided the adequate knowledge of using mobile learning technology in teaching.

Table 5.3 CATWOE Analysis of teachers (Cont.)

Key elements of theoretical		**Key elements applied in this study**
O: Owners	Those who control the systems	Thailand' government and Organisation/Institute (Thailand Ministry of Education)
E: Environment Constraints	Environmental constraints taken as given and which need to be considered	Technology, cost and time critical, budgets, quality education required

SSM Stage 4: Conceptual Models of Human Activities

A conceptual model was generated after the root definition of relevant systems were created. The conceptual model of human activities was developed in order to provide an understanding of change activities, which are required in a system and identified in the root definition. The conceptual model was established from a discussion of results that participants require in this research study.

Conceptual Human Activities Models

Regarding the questionnaire results, the opinions and attitudes of both teachers and school managers were used to design a conceptual model. Therefore, their requirements will be used to generate the first conceptual model, and then it will be used for improvement in the next stage of SSM (stage 5). The initial conceptual model is shown in Figure 5.8.

The next stage of SSM, stage 5, will compare the conceptual model of stage 4 with the real world, which is the in-depth requirement, and understanding of the use of mobile learning technology for teaching and delivering in primary schools (results of semi-structured interviews).

Conceptual Human Activities Model

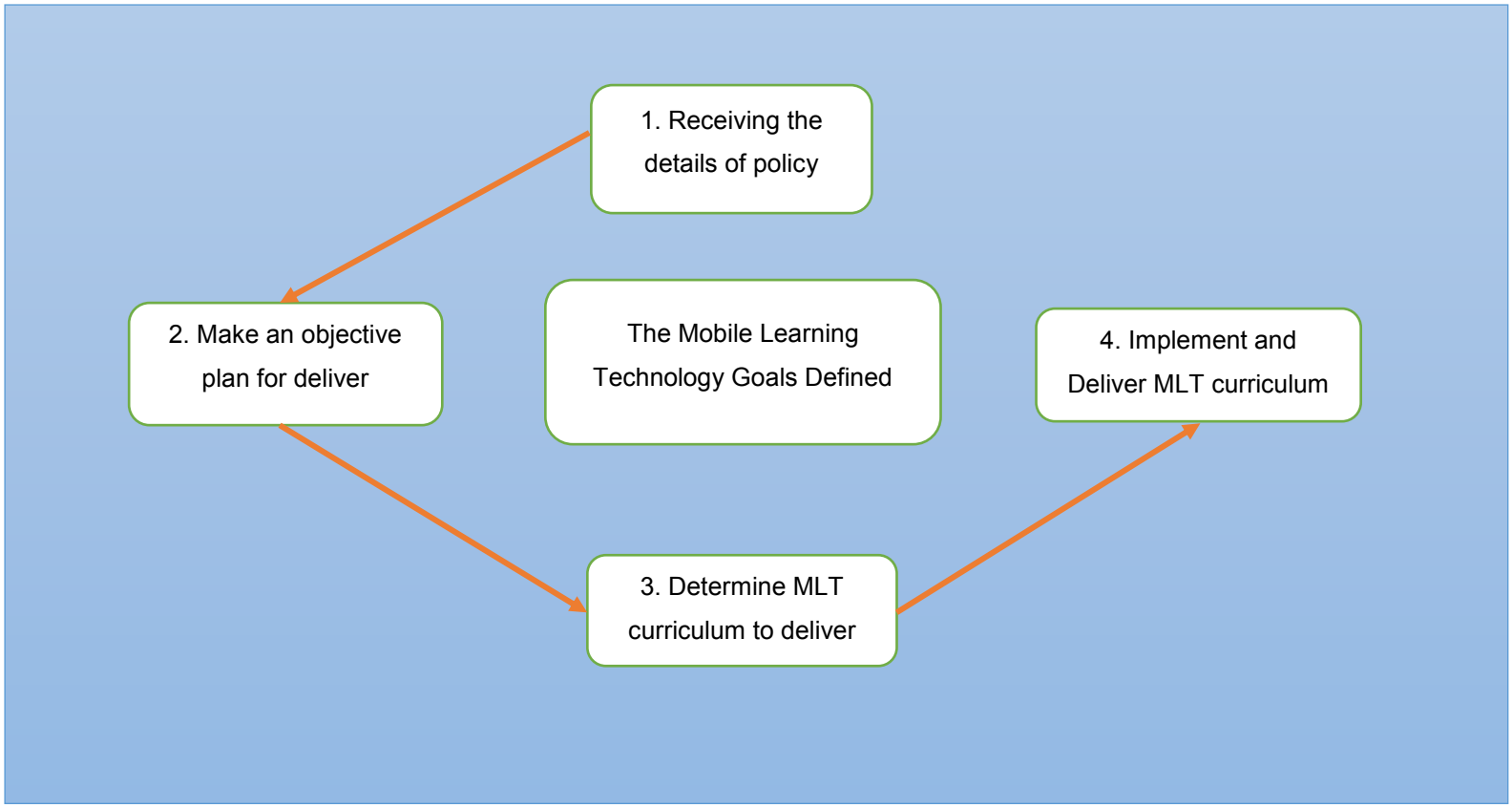

Figure 5.8 Conceptual Human Activities Model

SSM Stage 5: Comparison between conceptual models and the real world

The research objective 3 is to develop a novel of decision support model of mobile technology to guide in planning and delivering curriculum for using mobile learning technologies. This stage will consider and compare the conceptual model that was generated in stage 4 with the real world activities (stage 2). The purpose of this stage 5 will use the previous models (stage 4) to determine the possible changes that might improve the use of mobile learning technology in the primary school system.

Regarding the previous conceptual model in stage 4, in this stage we have to monitor the system in each step in order to find requirements from the collection of qualitative data through semi-structured interviews that we could use to determine which activities are performed effectively. It can be used to explore what activities are missing from the system, in order to complete the conceptual systems to be more effective. Therefore, in this stage we have to find the problem solution, by adding the requirements information into the system in order to provide and encourage the best possible system to guide users to be better in use.

After analysing the requirement, the activities list that the participants perceive as necessary for change and improving the conceptual model to the real world includes:

1. Explore Mobile Learning Technology requirements and issues.
2. Understand issues related to personal requirements.
3. Know the issues and find solutions, and support implementation of using MLT requirements.
4. Develop an appropriate MLT curriculum to deliver.
5. Monitor and manage the delivery of the MLT curriculum.
6. Review and develop the delivery of the MLT curriculum.

As described the list of the above six requirement approaches, leads to the development of an appropriate decision support model of MLT that will be used in primary schools. The new conceptual model (it can be called as a **Decision Support Model of Mobile Learning Technology**), when compared with the

real world, is improved by putting the requirements from the findings. This can be seen in the Figure 5.9 below.

The Decision Support Model of Mobile Learning Technology

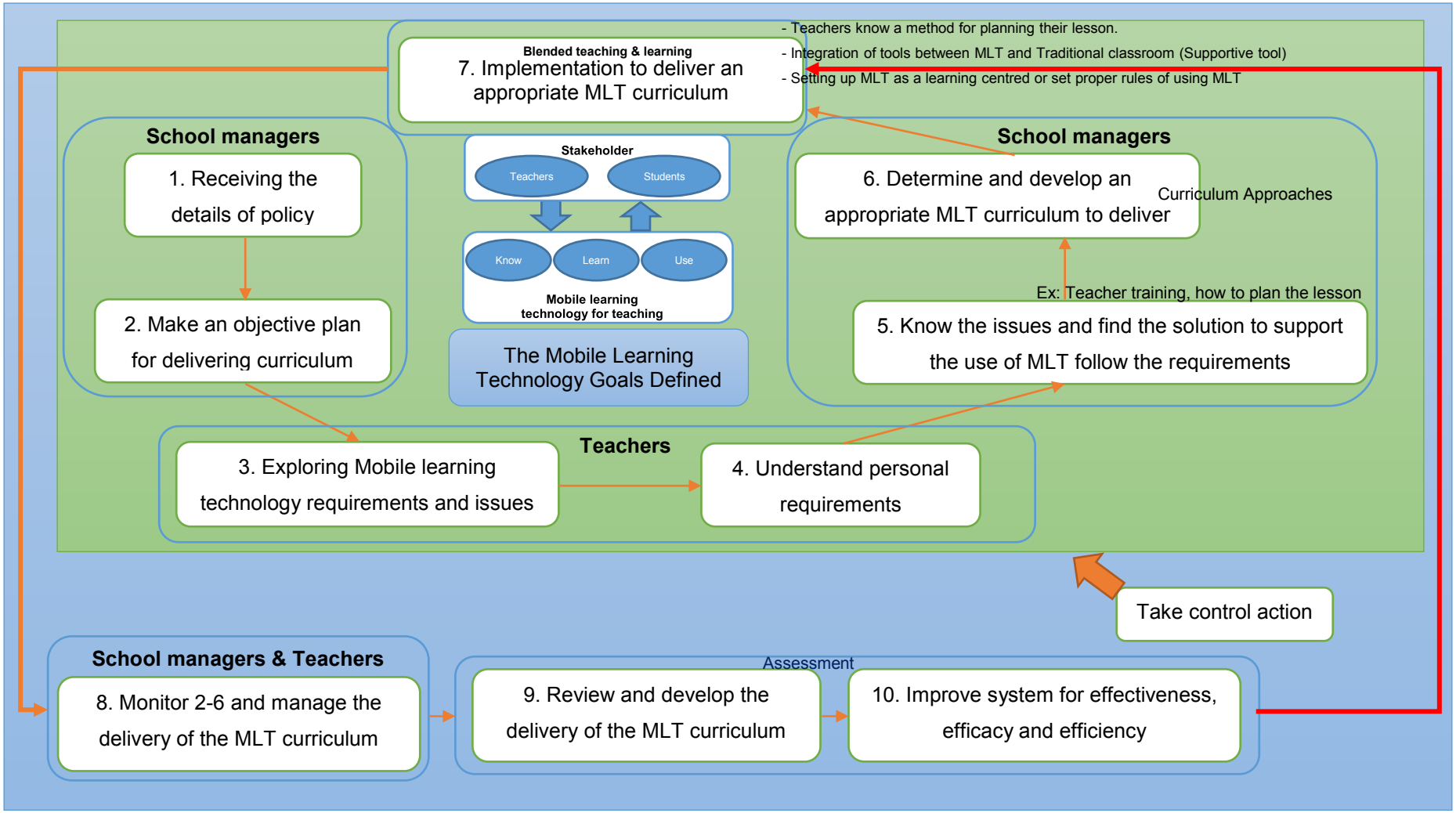

Figure 5.9 The Decision Support Model of Mobile Learning Technology

A new decision support model of mobile learning technology will be explained for each step. Looking at the new decision support model of mobile learning technology based on SSM techniques, the sequence of model processes will be described as follows:

1. Primary school receives the policy details from government or education ministry.
2. The school plans an objective for delivering mobile learning technology curriculum in primary school.
3. Before delivery MLT curriculum, we have to explore the requirements and problems of using mobile learning technology first.
4. Understand personal requirements and problems of MLT usage.
5. When understanding the MLT requirements and problems for example, teachers need guidance and training because they have limited knowledge of how to use mobile technology effectively for their teaching. After that, we need to find solution to support the needs.
6. Determine and develop an appropriate MLT curriculum following the requirements for delivering the curriculum.
7. Implement and deliver appropriate MLT curriculum for primary school by blending learning and use MLT as supplementary material.
8. Monitor processes 2 – 6 in order to manage the delivery of MLT curriculum.
9. Review, develop, and adapt the delivery of MLT curriculum.
10. Improve MLT system for effectiveness, efficacy, and efficiency in using and delivering curriculum.

When compared with the Soft System Methodology process, processes one to seven of the decision support model of MLT is the real world and processes eight to ten is systems thinking about the real world.

Note: If delivery of the MLT curriculum is of benefit and appropriate for primary school, it can stop the model at process seven (7). If not we can take control of the process and also go through processes eight (8) to ten (10) used to monitor, review and improve the MLT curriculum, then back to implementation and

delivery MLT curriculum again in order to most effectively use and deliver the MLT curriculum.

To summarise, this stage presented a decision support model of mobile learning technology that is needed to support teachers and school managers to utilise a mobile learning technology system for teaching and delivering curriculum in primary schools. In the case of teachers, the decision support model of MLT can be used to guide in the lesson planning and teaching process. In the case of school managers, the decision support model of MLT can be used to assist them to design and deliver effectively the MLT curriculum.

Yusof et al. model (2011) and Ng and Nicholas model (2013) were selected to adapt in this research in order to develop the MLT decision support model as each model has different strengths to implement mobile learning technology in schools. The strengths of Ng and Nicholas model (2013) highlighted the sustainability of using MLT systems in terms of interaction factors among stakeholders (users) and interactions in the use of mobile learning technology in schools. Also, the advantage of the Yusof et al. (2011) conceptual model presents the factors of blending mobile learning technology in the classroom as a guideline. The advantages of two models are provided, blending learning in the classroom and used as a centred and sustainable development for the use of mobile learning technology in school.

SSM Stage 6: Changes two criteria of desirables in principle and feasible to implement

In the previous stage, a decision support model of mobile learning technology was developed. The activities are relating to the model can be considered in this stage. There are two aspects of the possible changes: desirability and feasibility.

The purpose of this stage 6 of SSM is to test and evaluate the effectiveness, efficacy, and efficiency of the model in a real-world environment. This stage aims at testing and evaluating a decision support model of MLT that is appropriate to ensure in such a way in order to facilitate teachers and school managers to use MLT for effectively teaching in primary school.

This stage will be performed to display whether the decision support model of MLT has improved from the problem situation that related to the perspective of teachers and school managers. In addition, whether the decision support model of MLT implemented is consistent with the purposes in terms of two criteria of desirability and feasibility.

The stage 6 was developed from analysing data, discussion findings and the specific requirements (Por, 2008) of interviewees in order to determine how the use of mobile learning technology could be enhanced to support teachers to succeed in their MLT teaching and school managers to complete their delivery of an MLT curriculum. The purpose of the evaluation was to examine whether the decision support model of MLT was effective and appropriate for supporting and guiding teachers and school managers.

The evaluation process concentrated on two criteria that were tested from a quantitative perspective of teachers and school managers:

- Desirables in principle
- Feasible to implement

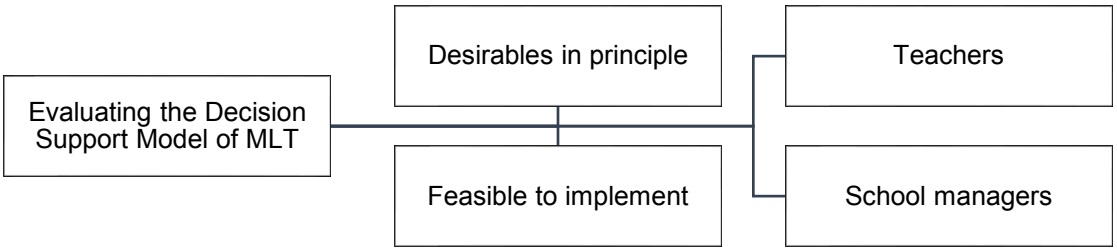

Figure 5.10 Evaluating the Decision Support Model of MLT

In order to evaluate the desirable and feasible changes, the following four questions were asked for improving the system.

1. Are the changes in the procedure of delivering teaching with mobile learning technology model desirable?
2. Are the changes in the procedure of delivering teaching with mobile learning technology model feasible?
3. Do the changes fit for the environment within the primary school?
4. Do the changes make the use of mobile learning technology easier for teachers to plan MLT lessons and easier for administrators to deliver the MLT curriculum?

Regarding the desirability and feasibility evaluation to change the decision support model of MLT, a rating scale was used in the questionnaires to evaluate as the following:

On a scale of 1 to 5, how satisfied were you with the decision support model of mobile learning technology guide based on the following criteria:
Use a scale from 1 to 5, where 1 being "very poor/low" and 5 being "excellent/very good". Please circle the number to complete for this question.

1 2 3 4 5

A total of twenty seven (27) participants took part in the evaluation of desirable and feasible aspects comprised of teachers and school managers. Those interviewees, who joined in the semi-structured interviews, included seventeen (17) teachers and ten (10) school managers. (See evaluation sheet in appendix G).

The findings of evaluation on the desirability and feasibility are as follows:

The sample of this study is fifteen (15) primary schools from various urban and rural parts of the Phitsanulok province in Thailand. All 27 participants participating in the semi-structured interviews are selected on the desirable and feasible evaluation of whom 17 are teachers (63.0%) and 10 school managers (37.0%) as shown in Table 5.4

Table 5.4 Position

Position	Frequency	Percent
School manager	10	37.0
Teacher	17	63.0
Total	27	100.0

According to four question of desirable and feasible evaluation, the results were summarised as shown in Table 5.5

Table 5.5 The findings of evaluation on the desirability and feasibility

Statements on evaluation	Very Poor	Poor	OK	Good	Very Good	Total	Average (Mean)
1. Are the changes in the procedure of delivering teaching with mobile learning technology model desirable?	0.0	0.0	29.6	48.2	22.2	100.00	3.93
2. Are the changes in the procedure of delivering teaching with mobile learning technology model feasible?	0.0	0.0	18.5	51.9	29.6	100.00	4.11
3. Do the model changes fit for the environment within the primary school?	0.0	0.0	11.1	59.3	29.6	100.00	4.19
4. Do the model changes make the use of mobile learning technology easier for teachers to plan MLT lessons and easier for administrators to deliver MLT curriculum?	0.0	0.0	7.4	55.6	37.0	100.00	4.30

In the previous table, evaluation criteria will be used to conclude the average of opinion on desirability and feasibility.

We use class interval width formula to define interval of opinion calculated by Sharma Sharma (2012) as follows:

$$Class\ interval\ width = \frac{MaximumValue - MinimumValue}{Class\ desired\ number\ (K)}$$

Consequently, the average score criteria is as follows:

Average score: 1.00 - 1.80 refer to Very poor

Average score: 1.81 – 2.60 refer to Poor

Average score: 2.61 – 3.40 refer to OK

Average score: 3.41 – 4.20 refer to Good

Average score: 4.21 – 5.00 refer to Very Good

Table 5.6 The results of evaluation of desirable and feasible features

Statements on evaluation	Average (Mean)	Summary Opinion Result
1. Are the changes in the procedure of delivering teaching with mobile learning technology model desirable?	3.93	Good
2. Are the changes in the procedure of delivering teaching with mobile learning technology model feasible?	4.11	Good
3. Do the model changes fit for the environment within the primary school?	4.19	Good
4. Do the model changes make the use of mobile learning technology easier for teachers and easier for administrators to deliver MLT curriculum?	4.30	Very Good

The data in Table 5.6 shows the results of evaluation of desirable and feasible features. It can be concluded that the average view of teachers and school managers on their assessment of desirable and feasible of decision support model of mobile learning technology agreed that the changing in the procedure of delivering mobile learning technology is good for planning and delivering curriculum. When asked about the feasibility of model changing in the decision support model of MLT, teachers and school managers agreed that the decision support model of mobile learning technology changes are feasible in a good way. Furthermore, they have good attitudes that the decision support model of MLT works well in their primary school environment. Most teachers' attitudes and school managers' attitudes were "very good" in the model change of the

decision support model of MLT, which could make it easier for teachers to plan MLT lessons and easier for administrators to deliver the MLT curriculum.

In summary, the results from this evaluation indicated that the average teachers' opinions and school managers' opinions agreed that the changing of the decision support model of mobile learning technology is desirable and feasible for them in the use of mobile learning in primary school education. The changes are suitable for their primary school environment. Additionally, the changing of decision support model of MLT is helpful for teachers to plan MLT lesson and assist school managers to deliver the MLT curriculum in their primary school. It can be concluded that teachers and school managers who are involved in using MLT, are satisfied and happy with the decision support model of MLT, which is useful for lesson planning and curriculum design, to make optimal use of the mobile learning technology in their school.

SSM Stage 7: Take action to improve the problem situation.

Stage 7 is the last stage of SSM that is used to take action for the system. In this stage, we will take the decision support model of mobile learning technology that we have improved from the problem situation and the evaluated the decision support model of mobile learning technology in the previous stage and apply it to the real world.

Therefore, at this stage it can be concluded that the improvement of the problem situation can be of benefit to teachers and school managers who are involved with the use of mobile learning technology for teaching. Regarding the decision support model of MLT in stage 5, and the results of changing in stage 6. We can summarise that the decision support model of MLT was clear that the process of the decision support model followed by the desirable and feasible changes provided opportunities to change teachers' attitudes and school managers' attitudes on the use of mobile learning in primary school.

5.2 Decision Support Model

Based on the evaluation of desirable and feasible features of the decision support model of Mobile Learning Technology (MLT) in the SSM stage 6, teachers and school managers have responded that they were satisfied with the decision support model of MLT. It is desirable and feasible, and suitable for using in their primary school environment in terms of planning lessons and designing the curriculum. This section highlights and discusses a diagram of a decision support model to advocate in this research.

Shim et al. (2002) stated that Decision Support Systems (DSS) are a system based on computer technology that has evolved to cope with making a decision on a problem. It has emerged to solve a problem and to advocate for deciding a complex situation. Traditionally, the potential of DSS is used for producing choices for users during their decision-making. In addition, DSS can support users (such as executive, managers) who need to solve specific problems or complex problems by providing information and decision support techniques on decision-making (Bijan Fazlollahi, 2001; Ong, 2014). Nachar (2016) listed advantages of DSS in assisting users for rapid decision-making, reducing time

to solve and fast analyse problems in terms of different information types, helping organisation to succeed in their goal and objectives and cost reduction. In contrast, there also are some disadvantages of DSS usage such as in the case of not having accurate database as a data source, the result of the decision may be an error or decision not applicable (Ong, 2014; Nachar, 2016). It can be concluded that the Decision Support System plays a significant role in the decision situation as an analysis tool in order to attempt to solve unstructured problems or specific problems. The DSS uses computer technologies to determine a process and implement a decision (Bidgoli, 2012). In addition, DSS also helps the decision-makers decide in order to obtain appropriate findings or best alternatives to achieve the organisation objectives.

Whilst Decision Support Models (DSM) are a system based on models or diagrams that have been created to assist users for deciding unstructured problems and to facilitate appropriate guidance to select tools or methods that optimise to use in the organisation system (Nilsen, 2015). Similarly, Uusitalo et al. (2015) presented in their paper that DSM is generated to aid the decision maker evaluate the best selection from the various management options that will lead to making the decision more efficient. They revealed that DSM is valuable to solve complex problems and may effectively manage options for considering added value for users who are the decision makers. DSM will be used as decision criteria in terms of finding methods that are suitable for planning which are expected to help to reduce risk and to increase effective management in an organisation. Moreover, DSM is used to enhance the efficiency and effectiveness in helping users to make the best decision (Pearson & Shim, 1995). Therefore, it can be seen that creating models in various forms has increased and become popular in order to use for approaching complex problems management.

In conclusion, the Decision Support Models (DSM) play a role as a diagram to assist to guide the decision maker in analysing information in order to solve unstructured problems or complex problems. It will be used to manage options by using information as a database to approach requirements and problems in determining appropriate mechanisms or providing guidelines for effective use

for the system. It can be said that the DSM is one procedure for the decision maker to use to decide effectively to succeed in the objective of systems.

Churchill and Wang (2014) indicated that using mobile technology in primary school as a teaching tool can encourage students' learning process and assist teachers' teaching. On the other hand, the findings of the requirements of using mobile learning technology (see chapter 4) indicated that almost all teachers and school managers are lacking guidance and training in using mobile technology for teaching and designing curriculum. Therefore, this research has created guidance as a decision support model (DSM) by using the analysis findings of quantitative and qualitative data that provide an idea to decision making in using mobile technology for teaching to planning MLT lesson and delivering MLT curriculum. It can be said that DSM of MLT is necessary for teachers and school managers in order to support them to decide to use MLT effectively at their primary school.

Consequently, the decision support model of the use of mobile technology for teaching in this study will use decision making to achieve an objective in planning an MLT lesson for teachers and designing an MLT curriculum for school managers in the primary school.

The next section will present the recommendation on using the decision support model of mobile learning technology.

5.3 Discussion

This research study aims to generate a decision support model of mobile learning technology for employing mobile technologies to support the delivery of primary education specifically addressing the needs of educators in areas to provide a teaching method to guide the assessment of mobile learning technologies. Furthermore, this chapter presented testing and evaluation the experimental of decision support model of MLT for teaching amongst teachers and managers of education systems and report on its effectiveness in delivering curriculum in the context of primary school education.

The findings in this section answer the first questions of this research study that was: How can the decision support model help to support the use of mobile learning technology for teaching?

This question concentrated on developing an in-depth understanding of the issues arising from the use of mobile learning technology for teaching in primary school. In this research study, the problem situations were related to using MLT in teaching and delivering curriculum from the teachers' perspective and school managers' perspective. Teachers require guidance and training and school managers require an appropriate model for delivering an effective MLT curriculum in the primary school. Hence, teachers and school managers need an appropriate decision support model of mobile learning technology in order to guide teachers in teaching with MLT and to guide school managers in designing the MLT curriculum. The problem situations of this research used the Soft System Methodology technique to generate the Rich Pictures for identifying the issues. The Rich Pictures is normally extracted from the systems underpinning the problem situations that the participants needed to concentrate on (Islam, 2013) as mentioned in Figure 5.1 to Figure 5.7. Moreover, Root definition and CATWOE analysis are used to analyse the issues and situations. The problem situations could be used to develop the activities required for a model that could help address the problem situations in order to provide critical guidance and support teachers in using MLT for teaching, and support school managers in effectively delivering MLT curriculum.

Based on the overall results, it appeared that the decision support model of mobile learning technology in this thesis was designed as a diagram, which highlighted to advocate the teaching of teachers and, support the curriculum designing of school managers for delivering in primary school. The decision support model of MLT provides a procedure as decision criteria to guide for planning the use of mobile learning technology in the context of primary school education. Botha et al. (2012) stated that mobile learning curriculum model was objectively designed to support and benefit teachers in the use of mobile technology for teaching.

In the case of teachers, decision support model of MLT could help them to plan a lesson more easily and teach with MLT. In the case of school managers, the DSM of MLT is helpful for planning and delivering the MLT curriculum in their primary school. Including, in the case of students, using mobile technology for learning in the classroom is fun, exciting, and useful (Pruet et al., 2016). The Decision Support Model of Mobile Learning Technology consists of seven main processes providing the process of the real world and three sub processes providing the systems thinking related to the real world. Compared to other related DSM of MLT, this DSM of MLT was specifically designed for primary school education to support teachers planning the lesson and support school managers delivering the curriculum. This DSM of MLT developed followed all critical SSM stages. The decision support model suggested that it was significant to support the use of MLT environments. We proposed that the DSM of MLT can be used to support as a guideline and reference for the development of MLT systems in primary schools (Yusof et al., 2011). In the model, we begin with exploring the requirements and issues of mobile learning technology in order to understand the different requirement of stakeholders (teachers and school managers) towards mobile learning technology in primary school education. Then finding the solution to support the requirements, also determine, and develop an appropriate MLT curriculum to deliver to teachers for effective planning of the MLT lesson.

Therefore, the decision support model of MLT has been highlighted to support and assist the development of the curriculum and plan lessons, particularly of a mobile learning technology to be used in primary school teaching and learning environments. Consequently, the decision support model of mobile learning technology for primary school teaching provides for better planning formulation and delivering in practice.

5.4 Summary

In summary, this chapter has presented the results from each stage of soft system methodology techniques used, in order to develop the model as a decision support model to guide for planning the use of mobile learning technology in primary schools. This section of the research study has presented

and described the decision support model of MLT, which reflects the use of MLT for teaching and delivering the curriculum in the MLT environment. This model can therefore answer the two previously stated research questions, which are related to establishing an appropriate and effective decision support model of mobile learning technology.

Chapter 6 A proposed decision support model to support mobile technology for teaching

Introduction to Chapter

This chapter answer the second question of this research that is, how to use a decision support model for supporting the use of mobile learning technology for teaching?

In this section, we present recommendations for how to use the Decision Support Model (DSM) to support Mobile Learning Technology (MLT) effectively that will be applied to support and enhance the quality of MLT usage in primary schools. Then, an evaluation of the process of developing the DSM for MLT and further evaluation of how well the model of MLT addresses supporting the use of mobile technology for teaching will be presented.

The Decision Support Model (DSM) of Mobile Learning Technology (MLT) in this research provides a guide for effectively using mobile technology for teaching. For teachers, the DSM for MLT can guide and support how to plan lessons by identifying the most appropriate features/applications for MLT teaching. For school managers, the DSM for MLT can support the design of the MLT curriculum in terms of identifying the need for using MLT for teaching and identify the alternative methods for MLT appropriate in primary school.

Hence, the DSM for MLT of this research will present a procedure for planning by offering options in order to plan effective MLT usage for designing and delivering the MLT curriculum in primary schools. Gerger (2014) indicated that a DSM can be used in order to accomplish educational planning that uses mobile technology for teaching in primary schools. Similarly Fulantelli et al. (2015) stated that the main use of decision support models has been adopted to reinforce educational decision-making in using mobile technology in teaching.

6.1 Recommendation to propose the decision support model to support mobile technology for teaching and delivering curriculum

As shown, a decision support model of mobile learning technology for teaching (Figure 5.9), for supporting the MLT curriculum in primary school education. It consists of seven main processes as follows: 1) receiving the policy details, 2) make an objective plan, 3) exploring requirements and problems, 4) understanding problems, 5) find the solution, 6) determine, and develop curriculum and 7) Implementation. Then follow the three sub-processes in terms of take control action as 8) monitoring, 9) reviewing and 10) improving the curriculum. Typically, teachers are involved in a stage of the lesson planning process. School managers are involved in a stage of curriculum designing process.

In the section below, a recommendation of each procedure will be provided in order to support effective usage of the decision support model of mobile learning technology as follows:

6.1.1 Government Policy

Primary schools receive policy details from the government or ministry of education. The policy details provide information for using mobile technology (Tablet PCs), as they need to develop Education Equality, improve education quality, increase equality of opportunity, and also reduce education inequality.

6.1.2 Make an objective plan

After the primary schools receive the policy, the planning stage of designing the MLT curriculum is a responsibility of school managers who have to define objectives and standards for the use of mobile technology for all teachers. The school managers will inform teachers about the objectives.

For example, based on the semi-structured interview results, most of the school managers from both urban areas and rural areas had a plan for delivering the curriculum to use MLT as a supplementary material in order to provide extra activities and extra practice.

6.1.3 Exploring requirements and problems

This process started when school managers received a new policy of MLT usage for teaching to deliver a curriculum and inform their teachers.
This allowed the teachers to give requirements and problems to include in the analysis and to support school managers' planning through the MLT curriculum. (1) Subsequently, the teachers will be asked to explore the MLT requirements and problems. (2) When exploring, the teachers and school managers try to understand personal requirements and problems in order to achieve in planning and designing the MLT curriculum.
The requirements and problems will be used to consider designing the MLT curriculum.

6.1.4 Understanding problems

Exploring requirements and problems of MLT usage, school managers, and officer/organisation involved with the use of the MLT system have to understand the answers of the teachers on the problems and requirements that will be entered into the next process of the decision support model. For example, What is the requirement? What is the problem?
From the findings of the questionnaire, the main problems of the use of MLT for teaching were that almost all teachers revealed that they have required more guidance and training because training is inadequate for them. They have limited knowledge and skill of how to use MLT effectively in their teaching.

6.1.5 Find the solution (Solution seeking the problems)

The school managers and officer/organisation acknowledge the requirements and problems. After that, the school manager will collaborate with teachers in order to explore the solution to support the use of MLT in order to develop the curriculum effectively.
This stage presents the choices of the solution following the requirements and problems. For example, training for teachers who have limited knowledge and skills to use mobile technology for teaching and who have to teach with MLT.
Before determining and developing MLT curriculum, we will question school managers and teachers for example, Is the solution suitable to satisfy delivering the MLT curriculum in their primary school?

6.1.6 Determine and develop curriculum

Next, the school managers determine and develop the MLT curriculum (curriculum approaches). They will give a curriculum description in terms of providing alternatives to teachers who have had MLT training in order to continue to plan the lesson and curriculum design.

According to the findings of the questionnaire and semi-structured interview results, school managers will deliver curriculum as (1). Integration of tools between MLT and traditional classroom as supplementary materials. (2) Setting up MLT as learning centres, which are somewhat similar to old-style language labs. They believed that MLT Learning Centres can be beneficial to both teachers and students.

6.1.7 Implementation

Finally, they can design and develop the MLT curriculum by analysing the alternatives and selecting one for implementation. We have to consider who will be involved in operating the new MLT curriculum, and motivate and train teachers concerned in using mobile technology for teaching.

Examples of implementation are to deliver the MLT curriculum, school managers will implement and deliver MLT curriculum in terms of blending learning and use MLT as supplementary material appropriate for using MLT in the classroom of the primary school.

In each of three academic subjects (Mathematics, English language, and Sciences), teachers have used the MLT as additional teaching media. The features/applications, which have been used when teaching with MLT in the classroom, are as follows: pictures, review/practice, animation, quizzes, and games.

Here, processes 8-10 take action control by feedback (assessment task), we will use these three processes for designing the MLT curriculum to employ in primary schools. We will examine and consider the problem. All three processes are defined in terms of monitoring, reviewing, and improving the designing of an appropriate MLT curriculum to use effectively in primary schools.

6.1.8 Monitoring

This process will consider and check the understanding of teachers and school managers that have influenced delivering the MLT curriculum by monitoring processes 2 – 6 in order to manage the delivery of the MLT curriculum. For example, Can you deliver the curriculum differently? Can you use other methods to solve this in order to deliver MLT curriculum effectively?

6.1.9 Reviewing

Reviewing stage will review, develop, and adapt the MLT curriculum change and adjust to facilitate a valid curriculum result. For instance, are there any environmental constraints, which make delivering MLT curriculum impossible to achieve the goals?

6.1.10 Improving the curriculum

Finally, per process monitor and review the MLT curriculum will be compared to the previous curriculum that has been designed and delivered by collaboration between teachers and school managers. Then improve the MLT system for effectiveness, efficacy, and efficiency in using and delivering the curriculum.

When compared with the Soft System Methodology Process, processes one to seven of the DSM of MLT are the real world and processes eight to ten are systems thinking about the real world.

We can stop the model at process seven (7). If not we can take control actions on the process and also go through processes eight to ten used to monitor, review and improve the MLT curriculum again for the most effective to use and to deliver MLT curriculum.

It can be seen that processes 8-10 are used for repeating or changing the MLT curriculum management in order to deliver the MLT curriculum. These three processes of assessment are crucial in terms of finding more requirements and problems in order to improve delivering MLT curriculum for teaching to increase

effectiveness, efficacy, and efficiency in using and delivering in primary school. (See figure 6.1)

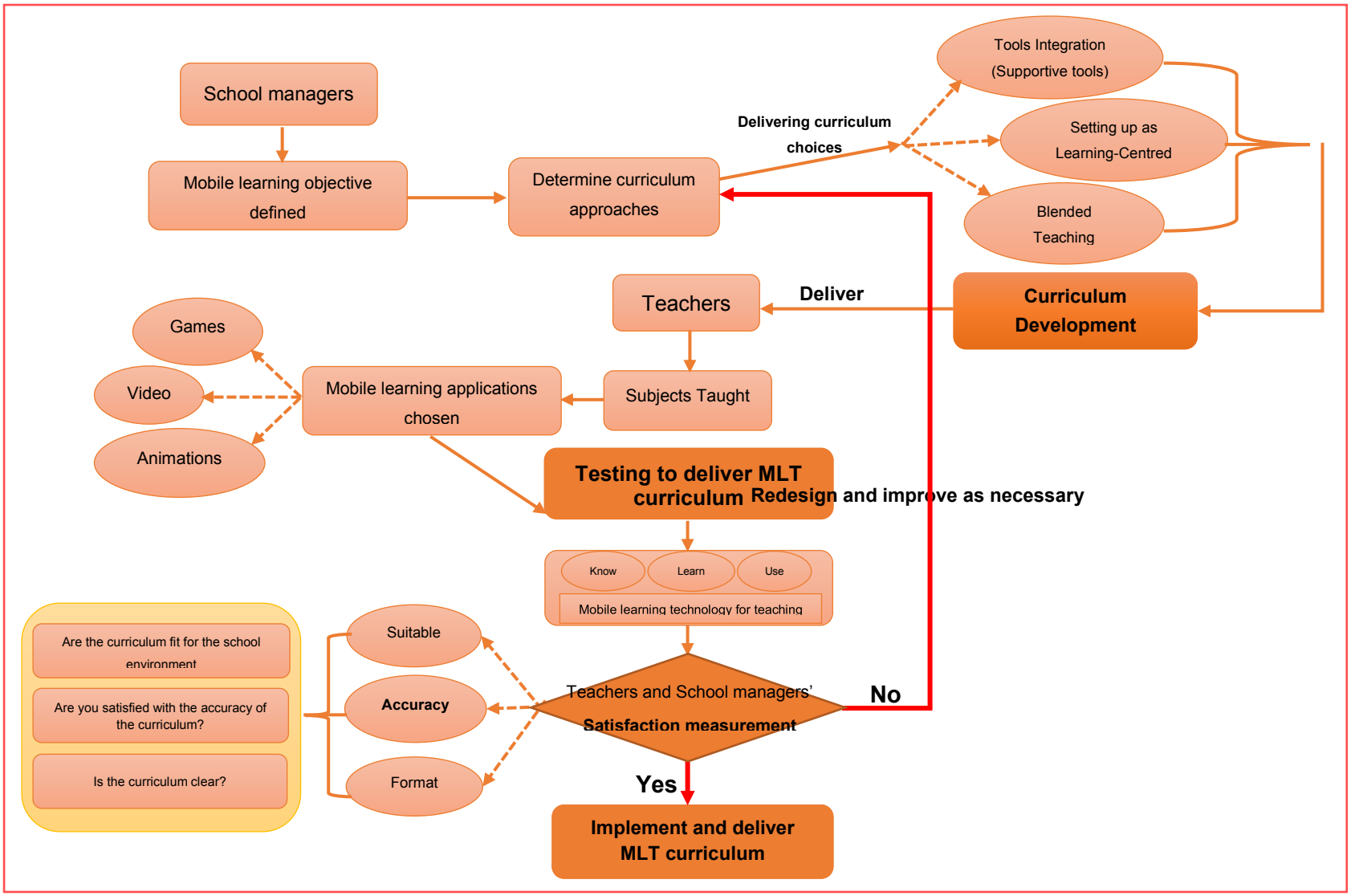

Figure 6.1 A diagram to demonstrate how model can help and measure the curriculum improvement

The Decision Support Model (DSM) of Mobile Learning Technology (MLT) can help teachers and school managers in terms of guiding them to good decision-making. The DSM of MLT provides an alternative in order to succeed in their planning teaching and designing curriculum.

Figure 6.1 above shows a diagram to demonstrate how DSM of MLT can help to monitor and measure the curriculum improvement. It shows that the decision support model of MLT begins when school managers define the objective to determine the curriculum approaches by the alternative of curriculum delivery (e.g., supportive tools, blended teaching, and set up learning-centred).

Then, develop curriculum and deliver to teachers to select features/applications in order to suit academic subjects. After that, testing and measurement satisfaction (e.g. suitable, accuracy, and format) of delivering the MLT curriculum in the primary school environment may be collected by using questionnaire or interview through knowing, learning and using mobile learning for teaching and delivering the curriculum.

If the curriculum is delivered appropriately in a school environment, where teachers and school managers are satisfied, then implement and deliver MLT curriculum. If not, redesigning and improving the curriculum is necessary.

The diagram shows a circular process where teachers and school managers provide feedback as required. Therefore, redesigning is crucial in order to improve the existing curriculum to be more effective and appropriate in the school environment.

6.2 Further evaluation of developing the Decision Support Model of Mobile Learning Technology

In this section, we will provide the further evaluation on the process of developing the decision support model (DSM) of mobile learning technology (MLT). Then will present the further evaluation of how well the decision support model of MLT addresses supporting the use of mobile technology for teaching.

6.2.1 Evaluation of the process of developing the model

Regarding how the decision support model of MLT was developed previously in this study, this section examines the further evaluation of the process of

developing the decision support model (DSM) of mobile learning technology (MLT).

The analysis of the questionnaire responses highlighted the importance of addressing the requirements, and basic problems of the use of mobile technology for teaching. Additionally, it presented the features/applications of mobile technology for teaching in various academic subjects. In order to use for considering which methods are appropriate for approaching the teaching that has been used in mobile technology in the primary school teaching. The survey results revealed that there is a little or no training for teachers. This means they do not know how to use mobile technology for effectively teaching especially older teachers. Therefore, teachers who have used mobile technology for teaching answered that training was required. Teachers should be trained in Mobile learning technology prerequisites in order to use mobile technology effectively for teaching and lesson planning. Moreover, the findings of the questionnaire have presented the features/applications that will be useful for designing the model.

The analysis of the semi-structured interview can indicate teachers' and school managers' requirements in terms of the specific problems that help to understand the problems and be aware of the cause of requirements. It was effectively used model development. It made the researcher consider an in-depth understanding of individual participants (between teachers and school managers) of the topic. It reflected specific problems, which can be used to provide more understanding of examination for the researcher. It was useful to know the individual viewpoints are what they need and what they want to do, in order to plan a lesson with MLT in the classroom, and guide school managers in curriculum design. The findings of the semi-structured interviews indicated that training, guidance/documents are the prerequisites necessary for MLT usage for teaching. In addition, it has been mentioned that mostly features/applications used in each academic subject have been classified.

Additionally, the analysis of Soft System Methodology provided guidance to identify the cause of the problems. In order to approach the mobile learning

technology model development, SSM was used to gather and analyse the finding of the questionnaire and semi-structured interview data to facilitate finding out the problem situations in order to improve active practice of the use of mobile technology for teaching in primary schools. It can be said that the SSM is a methodological approach, which is used to deal with the complicated problems and develop the model.

6.2.2 Evaluation of how well the decision support model addresses supporting the use of mobile technology for teaching

According to the recommendation of the use of decision support model of mobile learning technology, this section will present the evaluation of how well the decision support model addresses supporting the use of mobile technology for teaching.

The decision MLT model supports the use of mobile technology for teaching by guiding teachers in the use of instructional planning for the use of MLT in the classroom and assists them to get involved to optimise the teaching process. A DSM for MLT is generated based on a Soft System Methodology. It also advocates school managers for effective planning to curriculum design for use in the primary school (Fulantelli et al., 2015). For supporting teachers, it has been used in improving teaching and motivating for creating teaching activities in the classroom. Lee, Kwak, & Han (1995) indicated that the MLT model is an effective instructional tool to motivate stakeholders who are involved within the MLT system to use for planning the use of mobile technology for teaching at their school. Accordingly, Khaddage et al. (2015) stated in their studies that even though there are some theories of the use of mobile technology for teaching, teachers, and school managers still need a set of criteria for MLT usage or model to assist and support the use of mobile technology for teaching that also addresses MLT usage efficiently. For school managers, it has been used to advocate in guiding them in how to integrate MLT seamlessly into designing the MLT curriculum in order to deliver in primary school. The DSM can aid teachers and school managers adopt an MLT integrated into the traditional classroom-teaching environment that leads to achieving a successful mobile learning usage (Khaddage et al., 2015). In addition, Motiwalla (2007)

revealed that the MLT model providing the procedure helps teachers plan lessons and supports school managers design an effective MLT curriculum that can be used to complement traditional methods in the classroom.

Consequently, this section has been introduced to evaluate how well the decision support model addresses supporting the use of mobile technology for teaching. It can be said that the DSM can work well in terms of promoting educational decision making in using mobile technology for teaching. These make teachers and school managers know the guideline of delivering MLT in their primary school.

In terms of the planning of lessons, teachers are used to designing lessons. They decide which methods are appropriate for their subject teaching. This is provided in the section below, which method should be used in each subject.

This section will examine the different uses of mobile technology for supporting teaching in different academic subjects in terms of which features/applications work best for both teachers and students as follows: mathematics, science and languages (analysed from the findings of this research). Regarding the results of this research, it can be suggested that:

- Mathematics teaching, most teachers agreed that “games” are the best features/applications used for teaching with mobile technology. Games are useful in terms of encouraging students to practise so that they can improve their learning and understanding. Teachers would use them as exercises in their teaching, and they can motivate students learning Maths by making such exercises entertaining (Roberts & Vänskä, 2011).
- Language teaching, the appropriate features/applications have been used for language teaching with MLT such as video for example English cartoon video because the video feature works well for practising and reinforcing students to pronounce words and phrases. It helps students to improve their pronunciation. They can follow along and pronounce words in the cartoon video. Oz (2015) stated that video files have been

favourite features used in order for students to practise listening, pronunciation, and vocabulary studying.

- Science teaching, the features/applications which are especially well suited for science teaching, are animation and video. Because students can see, a virtual reality picture in the actual movement such as plant growth that makes it easier for the students to understand. According to the study of Khaddage et al. (2015) it was revealed that teachers of science have utilised MLT as an animation demonstration, as it will encourage students to become more interested.

This section is useful for teachers to select features/applications that work best to use with mobile technology for teaching. It can provide suitable features/applications to improve efficient use of mobile technology for teaching. Generally, most teachers agreed that they have used mobile technology as a supplementary media or additional teaching media, not as the main teaching method in the classroom. That is to say, they use mobile technology for teaching in terms of keeping students engaged and more interested.

The guidance as noted previously can provide a guideline for school managers to use a DSM for a development of MLT where the curriculum can be integrated with mobile technology and became part of the traditional curriculum.

This research has used the decision support model of mobile learning technology, to support the development, designing the lessons and delivering the curriculum through the use of mobile technology for primary school teaching. This proposes generating the model, for answering the question of this research as: How can the decision support model help to support the use of mobile learning technology for teaching and how to use a decision support model for supporting the use of mobile learning technology for teaching. Then we have proposed the use of mobile learning technology for teaching in chapter 5 (section 5.2) and chapter 6 (section 6.1). The DSM has been used to present the procedure in order to plan MLT lessons and design the MLT curriculum that will be used in the primary school.

6.3 Summary

In summary, this chapter has described the recommendations for the decision support model of mobile learning technology to support planning and delivering the MLT curriculum in primary school. Considering the use of mobile technology for the teaching environment, the school manager, the teacher, and mobile learning technology were key contributors to a teaching system in the mobile learning technology environment. Thus, the further evaluation of the process decision support of model development, and evaluation of how well the decision support model addresses supporting the use of mobile technology for teaching, has been presented. The following chapter 7 will present the conclusion of this research study.

Chapter 7 Conclusions

Introduction to Chapter

This thesis has concentrated on the design and development of a decision support model of mobile learning technology, which can be carried out in complicated problem situations and able to adapt to changing the real world environments.

This chapter discusses the achievements that have been completed in this research along with a thesis conclusion and an outline of future work to be carried out.

In this research investigation and analysis the use of mobile learning technology for teaching in developing countries and then develop a novel of decision support model of mobile learning technology suitable for primary schools teaching. Firstly, a conclusion to the present research study to be used for the improvement and development of teaching with mobile learning technology. Secondly, a critical discussion from the overall work. Finally, the limitation and future work of this research are presented. The research methodology was based on the Soft System Methodology. The research methods were mixed-methods: a quantitative questionnaire on the requirements for mobile learning technology (The samples were 335 teachers and 63 school managers in 193 primary schools) and Qualitative semi-structured interviews on the perspective of teachers and school managers in the use of mobile learning technology (The samples were 17 teachers and 10 school managers in 15 primary schools). Questionnaires on the evaluation of desirable and feasible aspects of the decision support model of mobile learning technology were collected from a sample of 17 teachers and 10 school managers who also participated in semi-structured interviews. All data was analysed and presented in tables. The results are summarised as follows:

7.1 Conclusions

This research study developed a Decision Support Model (DSM) for Mobile technology enhanced teaching (MLT) for use in the context of primary school education. This research study should be useful for both teachers and school managers. In the case of teachers, the DSM of MLT can be useful for guiding in decision-making and designing MLT lesson plans and using MLT as a learning tool for supporting primary school education. The decision support model of MLT can help them use MLT to teach in the classroom effectively. In the case of school managers, the DSM of MLT can serve and assist them as a reference for designing MLT curriculum, making it easier to plan and create curriculum in the future.

For analysing and designing the decision support model of mobile learning technology, this study used the results of the analysis of the use of mobile learning technology for teaching and delivering curriculum to generate the DSM of MLT. The findings of the requirements for the use of mobile learning technology were as follows; most teachers have indicated that they lack guidance and training. Consequently, guidance and training in using mobile technology are necessary for teacher training. Teachers need a model to use mobile learning technology. The DSM of MLT can be used to deploy technology-enhanced teaching and learning that can provide a variety of uses as follows: The first point to note is the DSM of MLT can improve the potential of teachers to the use of mobile learning technology for supporting students in learning so that they have more quality in their teaching. The second point to note is the DSM of MLT supports effective teaching and learning activities and third increasing student engagement in learning.

After the decision support model (DSM) of mobile learning technology (MLT) was developed, this study has evaluated the DSM of MLT by using questionnaires on the desirability and feasibility of such features. The evaluation indicated that the average view of teachers and school managers on their assessment of desirable and feasible aspects of the Decision Support Model of Mobile learning technology were 3.93, and 4.11 respectively.

Furthermore, both teachers and school managers can modify the DSM of MLT to make it appropriate for each given primary school environment. The use of mobile learning technology makes it easier for teachers to plan MLT lessons and easier for school managers to deliver the MLT curriculum.

At the beginning of the research, this study has discussed the research motivation, provided the research questions, and research objectives, which emerged from the motivation of this research. Four main research objectives were determined:

1. To complete an in-depth literature review in the areas of mobile learning technologies for elementary school teaching.

According to the literature review mobile learning technology presents a new way for both learning and teaching that can improve performance of teaching methods, and gain skills knowledge, which can be powerful teaching aids for teachers. Using MLT as a technology tool is convenient for teachers by combining it with the use of textbooks in the classroom so that the teacher can make learning more fun for young students. Various researches focus on the use of mobile technology in learning and teaching in developing countries. For example, teachers in Indonesia and Malaysia who have used mobile learning in their teaching expressed the view that MLT can save their teaching time and preparation time. Moreover, MLT can encourage student engagement and do activities both in the classroom and outside the classroom. Nevertheless, teachers and school managers in developing countries encounter difficulties in the use of mobile technology in teaching and delivering the curriculum. Regarding the problems of the use of technology, this research aims to decrease the current gap of implementing mobile learning technology in primary school for teaching in the classroom and delivering the curriculum which is a key problem. Teachers and school managers have encountered teaching technologies that they do not know how to use properly and effectively. As a result, teachers and school managers in primary schools may be lacking an appropriate guidance and training. Therefore, this research has addressed the gap between needs and problems to generate the mobile learning technology

model providing a procedure for the effective and appropriate use of mobile technology in primary school teaching.

2. To collect and analyse data for the requirements of mobile technology enhanced teaching.

Considering the findings of requirements, opinions, and attitudes related to the use of mobile learning technology enhanced teaching and delivering curriculum. The requirements from the questionnaires found that most teachers and school managers agreed that they lack the experience of using mobile technology and they lack the experts to teach and deliver the curriculum relating to the use of mobile learning technology. Therefore, the requirements of teachers and school managers are guidance and training in the use of mobile learning technology. In addition, teachers and school managers have a suggestion that for effectively using mobile learning technology in primary schools it should be used as an additional teaching aid in the form of supplementary material or teaching aids in the classroom by integrating mobile learning technology into their teaching techniques. This was helpful for motivating students' learning, stimulating students' thinking. In the case of teachers, MLT can aid teaching in terms of reducing the workload and reducing preparation time of teachers that can provide effective teaching and can create attractive teaching. One of the challenges of using MLT is that of pupil distraction. For reducing any distraction caused by using MLT in the classroom environment, teachers and school managers suggested that MLT should be set up as a Learning Centre or setting rules for using MLT in the classroom.

Therefore, in order to improve teachers' and school managers' ability, this data collection will be used to analyse their requirements, which help them to be effective in planning MLT lessons and delivering the MLT curriculum. The decision support model will be significant for them, and will encourage teachers to be better at teaching with MLT and will assist school managers to be better at delivering the MLT curriculum, before using MLT in curriculum teaching.

3. To develop a novel decision support model of mobile technology enhanced teachiing to guide in planning and delivering curriculum using mobile learning technologies.

Regarding the development of a novel decision support model of mobile learning technology based on SSM techniques, this was created to guide in planning and delivering the curriculum. The objective of the novel DSM of MLT was to assist the teaching and delivering process, which is used to understand the development procedure of mobile learning technology in the primary school education system. Consequently, this research study provides an appropriate and effective decision support model of mobile learning technology that was designed to support the teaching of teachers and support school managers in delivering the curriculum. The decision support model for the MLT provides a procedure to guide for planning and properly utilising mobile learning technology in the context of primary school education. The DSM of MLT has highlighted the need to support and assist the development of the curriculum and plan lessons in particular for mobile learning technology to be used in primary school teaching and learning environments. The DSM of MLT begins by exploring MLT requirements and issues in order to contribute to understanding the issues, and find the solution to support the MLT requirements which could be used to consider in the development an appropriate MLT curriculum. Providing the delivery of mobile learning technology system to be used in primary school education in the form of blending MLT in the curriculum. In conclusion, the decision support model of mobile learning technolgy can answer two research questions. It appeared that the novel of DSM of MLT is helpful for providing guidance in the use of mobile learning technology and it was important to support teaching and delivering the MLT curriculum. In the case of teachers, the decision support model of MLT was used for designing MLT classes, lesson planning and teaching process and methods. In the case of school managers, the DSM of MLT was used for delivering MLT curricula specifically in the context of primary school in developing countries.

4. To test and evaluate the effectiveness, efficacy and efficiency of the experimental model in a real-world environment.

Considering the test and evaluation of the decision support model of MLT, all 27 participants including 17 teachers and 10 school managers participated in this evaluation. The evaluation process also revealed teachers‘ and school managers‘ perspectives agreed the changing of the desirability and feasibility of the decision support model of MLT which was effective to support their planning and delivering the MLT curriculum. They expressed that the new decision support model of mobile learning technology of this research is useful for them in terms of teachers and school managers will use mobile technology better for teaching and delivering MLT curriculum. It being easier for teachers to plan MLT lessons and easier for school managers to deliver the MLT curriculum in the primary school environment.

7.2 Critical discussion

This research has developed a decision support model for mobile learning technology for teaching activities, designing, and delivering a curriculum that focuses on Thai primary schools. The development of a decision support model of MLT based on Soft System Methodology, and mixed methods (quantitative as questionnaire and qualitative as a semi-structured interview) were used for collecting data.

However, many processes were employed in this research. This research has some limitations that could be addressed in future studies. Firstly, this research only collected data from the teachers and school managers of Northern Thai primary schools specifically Phitsanulok province. Moreover, a sample of teachers and school managers of primary schools to take part in semi-structured interviews may have potential bias due to willing respondents (e.g. convenient participants) and may not support a generalisation, since this study gathered data from only 15 primary schools from target 20 schools in Phitsanulok province. Although the primary schools are from both urban and rural areas and from both public and private schools parts of Thailand, collecting the data from 15 Thai primary schools could possibly limit generalisability of the findings to the whole population. This means that the findings of this research could be generalised in the other parts of Thailand.

Therefore, in the future, this research should also be randomised and data collected covering the primary schools of many areas in Thailand, for example, in South, East, and West of Thailand in order to provide a larger-scale attitude of mobile learning technology usage. Additional, in order to make generalisations of the decision support model of mobile learning technology, this research would need to sample other levels of school (e.g. secondary schools, high schools, and university).

Secondly, as mentioned above, time constraints were associated with data collection, specifically, semi-structured interviews via face-to-face. It may have some uncontrollable factors (e.g. a readiness of participants, some respondents may not answer the actual question), time limitation, appointments, and distance. If future researchers wish to improve data collection, they could use other types of semi-structured interview such as, phone interview and video interview or online interview via Skype.

Finally, the use of a decision support model of mobile learning technology may have some bias for some of the results. Future research should evaluate the effects of implementing the approach of DSM of MLT in practice.

7.3 Limitation

A limitation of this study is the data collection of questionnaires should be widely conducted in other parts of Thailand. Time constraint in data collection is a crucial limitation of this study. In addition, the questionnaire depends on self-reported data; thus, participants of this study may not have answered reliably or accurately where there is no method to confirm their answers.

The sample group of this study involved teachers and school managers from only Phitsanulok province, which limits the generalisability of this study.
The study did involve 15 schools in the Phitsanulok province in Northern Thailand. This province has similar population characteristics and similar proportions of urban and rural areas to the majority of other provinces in Thailand. Additionally, the decision support model of MLT of this research can be used to support teachers and school managers who are using mobile

technology in teaching, and provides some of the ways for supporting the use of mobile learning technology in primary schools in Thailand. This research was only able to present a case using one part of Thailand (North of Thailand). These limitations prove the need for future research that includes more random sampling from many provinces/parts of Thailand to provide a large-scale view.

7.4 Future work

The decision support model of mobile learning technology was developed as a guideline model or technical support for effectively using mobile learning technology in primary school. The DSM of MLT presents approaches that can be used to support teaching within the traditional classroom and is expected to be used in class to help to start the lesson plan and deliver the curriculum in primary schools especially in the context of Phitsanulok Thailand.

For future research, this decision support model of mobile technology enhanced -teaching could be enhanced via a larger scale study covering further areas of Thailand and could be introduced and developed to replicate in various ways. The sample should randomise other geographical areas (e.g., South, East, and West of Thailand) in order to make generalisations. Additional other school levels (e.g., secondary school, high school, and university) are needed to make the decision support model of mobile learning technology of this research generalizable. Moreover, research is needed to evaluation the effects of implementing approach the DSM of MLT in practice.

The appropriate features/applications were presented in the section of evaluating how well the decision support model addresses supporting the use of mobile technology for teaching, in the future, it can be brought to use as a recommendation to improve teaching features/applications if required.
In terms of technicality, further work could be done to improve the minimum infrastructure such as network connectivity (WI-FI) and standardisation of devices.

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APPENDICES

Appendix A: The Questionnaire (Final Version)

Questionnaire for the Requirements of Mobile Learning Technology

You are being invited to take part in a research project which involves gathering information on current methods for delivering, teaching and understanding the curriculum needs in primary education.

Please answer the following questions in relation to the mobile learning technology enhanced teaching in which you are involved. Your answers will be kept confidential and will be used only for this research. As well as ticking the relevant boxes, please add any comments you may have on this questionnaire.

1. Personal Information

1.1 Position

☐ Administrator of school ☐ Teacher

1.2 Place of your school

☐ Urban area ☐ Rural area

2. Using mobile technology in teaching Background

2.1 Do you have any experience in using mobile technology in education?

☐ Yes ☐ No

If your answer is **"No"** Please answer the following question. If not please go to question 2.3

2.2 Which of the following factors do you think could be the reason for your lack of use of mobile technology in education?

☐ Lack of guidance and training

☐ Remote distance

☐ Lack of support from leadership

☐ School not ready for mobile technology

☐ Others (please specify)……

2.3 For teaching, which academic subjects do you use mobile technology?

☐ Mathematics ☐ English Language

☐ Sciences ☐ others (please specify)……

2.4 What features/applications of mobile technology do you use for teaching?

☐ Electronic Books (Pdf., ePub) ☐ Video (MP4)

☐ Pictures (Jpg, Png) ☐ Sound (MP3)

☐ Multimedia (Flash) ☐ Animation

☐ Work class Exercise ☐ Audio Clips

☐ Reading content ☐ Activity

☐ Review/Practice ☐ Quiz

☐ Simulation ☐ Games

☐ Others (please specify)……..…

2.5 Do you think mobile technology is useful for teaching?

☐ Yes ☐ No

If you answer **"Yes"** please answer the question 2.6. If not please go to question 2.7

2.6 Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply)

☐ Mobile learning technologies can improve the effectiveness of teaching

☐ Mobile learning technologies can improve pupils' engagement and interaction

☐ Mobile learning technologies can improve pupils' enthusiasm

☐ Mobile learning technologies can motivate students to study

☐ Mobile learning technologies can make learning activities fun

☐ Mobile learning technologies can help make teaching more attractive.

☐ Mobile learning technologies can assist students to participate in learning activities.

☐ Contents of subject are match for using mobile technology

☐ Other (please specify).....

2.7 Why do you think that mobile learning technology is not useful for teaching? (Please tick three most important that apply)

☐ Waste of time

☐ Waste of money and resources

☐ Inappropriate environment

☐ Curriculum is not supported

☐ Technological development

☐ Mobile learning technologies may contribute to distraction in classroom

☐ Other (please specify).....

2.8 How frequently have you utilised mobile technology to help you teach?

☐ Frequently ☐ Rarely

☐ Occasionally ☐ None

2.9 Do you like using mobile learning technologies for teaching?

☐ Yes ☐ No

2.10 What is your opinion on the validity of the following statements when using mobile learning technology for teaching?

Please tick the answer you think most appropriate with statement below

Statements on your opinion to not like using mobile learning technology	**Strongly Disagree**	**Disagree**	**Neither**	**Agree**	**Strongly Agree**
1. Poor or no internet connection					
2. Number of devices are not enough					
3. Teachers lack the experience of using mobile technology					
4. There is a lack of expert to teach how to use of mobile technology					
5. Mobile technologies have limited use					

Statements on your opinion to not like using mobile learning technology	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
6. Mobile technologies are very complex					
7. Preparing contents for Mobile Technology is a waste time					
8. Poor design of technologies features					

3. Did you find mobile technology effective in supporting your teaching in class?

☐ Yes ☐ No

4. How did you find mobile technology effective in supporting you to teach outside of the classroom?

☐ Students can review lesson by themselves

☐ Increases communication between student and teacher

☐ Others (please specify)……

5. How significant is mobile technology in aiding students understanding teaching materials?

On a scale of 1-5: (1) poor, (2) fair, (3) good, (4) very good and (5) excellent please circle the number to complete for this question.

1 2 3 4 5

6. What is the most important factor of the following statements when choosing your mobile learning technology for teaching?

Please circle the rate you think most appropriate with the following statement below.
Scale of 1 – 5: (1) Not important, (2) Neither Important nor Unimportant, (3) Important, (4) Very Important and (5) Extremely Important

Statements on the important factor of using mobile learning technology					
1. Suitable for subject area	1	2	3	4	5
2. Facilitate	1	2	3	4	5
3. Reduce time to teach	1	2	3	4	5
4. Provide educational opportunities for learning	1	2	3	4	5
5. Mobile learning technology can make materials interesting and easy to understand	1	2	3	4	5
6. Mobile learning technologies are convenient	1	2	3	4	5

7. How did you find teaching using mobile technology?

On a scale of 1-5 with 5 being excellent/high/easy and 1 being poor/low/difficult, please circle the number to complete for this question.

1 2 3 4 5

8. Would you like to have more teaching materials available on mobile technologies?

☐ Yes ☐ No

9. Would like to be able to interact with your learner via mobile learning technology regarding concerns related to the curriculum?

☐ Yes ☐ No

10. What is your attitude towards the use of mobile technology in teaching?

☐ Negative ☐ Neutral ☐ Positive

11. Please state any further comments about using mobile technology for teaching?

……

……

……

Thank you for completing this questionnaire

Appendix B: The Questionnaire (Thai Version)

แบบสอบถามความต้องการเทคโนโลยีโมบายเลิร์นนิ่ง
(Questionnaire for the requirements of Mobile Learning Technology)

คำชี้แจง แบบสอบถามฉบับนี้จัดทำขึ้นเพื่อศึกษาถึงความเข้าใจและความต้องการของหลักสูตรระดับชั้นประถมศึกษาต่อการใช้เทคโนโลยีโมบายเลิร์นนิ่งในการเรียนการสอนผู้วิจัยใคร่ขอความกรุณาท่านตอบแบบสอบถามตามความเป็นจริงข้อมูลที่ได้รับจักเป็นประโยชน์อย่างยิ่งต่องานวิจัยในการพัฒนาโครงร่าง(Model)การใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอนเพื่อให้งานวิจัยสำเร็จตามวัตถุประสงค์ ผู้วิจัยใคร่ขอความกรุณาในการตอบแบบสอบถามเกี่ยวข้องกับเทคโนโลยีโมบายเลิร์นนิ่งในการช่วยยกระดับพัฒนาหลักสูตรและส่งเสริมการสอนโดยข้อมูลจากการตอบแบบสอบถามดังกล่าวจะถูกเก็บไว้เป็นความลับและถูกใช้สำหรับการวิจัยนี้เท่านั้น

คำอธิบาย Mobile Learning Technology หรือ **เทคโนโลยีโมบายเลิร์นนิ่ง** คือ การเรียนการสอนหรือการเรียนรู้โดยผ่านอุปกรณ์โทรศัพท์มือถือหรือเครื่องคอมพิวเตอร์แบบพกพาเชื่อมต่อข้อมูลแบบไร้สาย เช่น โทรศัพท์มือถือ (Smart Phones), แทบเลต(Tablet PCs), พีดีเอ(PDAs: Personal Data Assistant) เป็นต้น สามารถเรียนรู้ได้ทุกที่ทุกเวลา ซึ่งทำให้เกิดโอกาสในการเรียนรู้ได้เพิ่มขึ้น

ขอขอบพระคุณทุกท่านเป็นอย่างสูงที่กรุณาสละเวลาในการตอบแบบสอบถามมา ณ โอกาสนี้

สุภรวดี ตรงต่อธรรม
นักศึกษาปริญญาเอกมหาวิทยาลัย ลิเวอร์พูล
จอห์น มอร์สHulya Francis, Dr Mark taylor and Dr Sud Sudirman
ทีมที่ปรึกษางานวิจัย

คำชี้แจง กรุณาทำเครื่องหมาย ✓ หน้าตัวเลือกที่ตรงกับท่านมากที่สุด

1. ข้อมูลส่วนบุคคล

1.1 ตำแหน่ง (Position)

☐ ผู้อำนวยการโรงเรียน (Executive of school) ☐ ครูผู้สอน (Teacher)

1.2 สถานที่ตั้งโรงเรียน (Location of your School)

☐ ในเมือง (Urban) ☐ นอกเมือง (Rural)

2. ข้อมูลด้านการใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอน

2.1 ท่านมีประสบการณ์ในการใช้เทคโนโลยีโมบายเลิร์นนิ่ง (Mobile Learning Technology) ในการเรียนการสอนหรือไม่ (Do you have any experience in using mobile technology in education?)

☐ มี (Yes) ☐ ไม่มี (No)

ถ้าท่านตอบว่า "**ไม่มี**" กรุณาตอบคำถามข้อ 2.2 แต่ถ้าท่านตอบว่า "**มี**" กรุณาข้ามไปตอบคำถามข้อที่ 2.3

(If your answer is "**No**" Please answer the following question. If not please go to question 2.3)

2.2 ท่านคิดว่าเหตุผลใดที่ทำให้ท่านขาดการใช้เทคโนโลยีโมบายเลิร์นนิ่ง (Mobile Learning Technology) ในการเรียนการสอน (Which of the following factors do you think could be the reason for your lack of use of mobile technology in education?)

☐ ขาดการแนะนำและฝึกอบรม (Lack of guidance and training)

☐ ระยะทางความห่างไกลของโรงเรียน (Remote distance)

☐ ขาดการสนับสนุนจากผู้นำของโรงเรียน (Lack of support from leadership)

☐ โรงเรียนไม่มีความพร้อมในการใช้โมบายเทคโนโลยี (School not ready for mobile technology)

☐ อื่นๆ (โปรดระบุ) (Others (please specify))…….....

2.3 ท่านใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอนวิชาใด (For teaching which academic subjects do you use mobile technology?)

☐ คณิตศาสตร์ (Mathematics) ☐ ภาษาอังกฤษ (English Language)

☐ วิทยาศาสตร์ (Sciences) ☐ อื่นๆ (โปรดระบุ) Others (Please specify)……

2.4 ลักษณะ (Features) หรือโปรแกรมประยุกต์ (Applications) แบบใดของเทคโนโลยีโมบายเลิร์นนิ่งที่ท่านใช้ในการสอน (What features/applications of mobile technology do you use for teaching?)

☐ หนังสืออิเล็กทรอนิกส์ (Electronic Books (Pdf., ePub)) ☐ วิดีโอ (Video (MP4))

☐ รูปภาพ (Pictures (Jpg, Png)) ☐ เสียง (Sound (MP3))

☐ สื่อประสม (Multimedia (Flash)) ☐ ภาพเคลื่อนไหว(Animation)

☐ แบบฝึกหัดในห้องเรียน (Work class Exercise) ☐คลิปเสียง (Audio Clips)

☐ ข้อมูลแบบอ่าน (Reading content) ☐ กิจกรรม (Activity)

☐ บทเรียนทบทวน/แบบฝึกหัด (Review/Practice) ☐ แบบทดสอบ (Quiz)

☐ สถานการณ์จำลอง (Simulation) ☐ เกมส์ (Games)

☐ อื่นๆ (โปรดระบุ) Others (Please specify).....

2.5 ท่านคิดว่าเทคโนโลยีโมบายเลิร์นนิ่งมีประโยชน์ต่อการสอนของท่านหรือไม่ (Do you think mobile technology is useful for teaching?)

☐ มีประโยชน์ (Yes) ☐ ไม่มีประโยชน์ (No)

ถ้าท่านตอบว่า "**มีประโยชน์**" กรุณาตอบคำถาม 2.6 แต่ถ้าตอบว่า "**ไม่มีประโยชน์**" ข้ามไปตอบคำถามข้อ 2.7 (If you answer "**Yes**" please answer the question 2.6. If not please go to question 2.7)

2.6 ทำไมท่านคิดว่าเทคโนโลยีโมบายเลิร์นนิ่งมีประโยชน์ต่อการสอนของท่าน (ตอบ 3 ข้อที่ท่านเห็นว่าสำคัญสุด) (Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply))

☐ เทคโนโลยีโมบายเลิร์นนิ่งสามารถเพิ่มประสิทธิภาพในการสอน (Mobile learning technologies can improve the effectiveness of teaching)

☐ เทคโนโลยีโมบายเลิร์นนิ่งสามารถเพิ่มความมีส่วนร่วมและช่วยเพิ่มให้ผู้สอนกับนักเรียนมีปฏิสัมพันธ์ร่วมกันมากขึ้น (Mobile learning technologies can improve pupils' engagement and interaction)

☐ เทคโนโลยีโมบายเลิร์นนิ่งสามารถเพิ่มความกระตือรือร้นและความสนใจให้กับนักเรียน (Mobile learning technologies can improve pupils' enthusiasm)

☐ เทคโนโลยีโมบายเลิร์นนิ่งสามารถกระตุ้นนักเรียนในการเรียน (Mobile learning technologies can motivate students to study)

☐ เทคโนโลยีโมบายเลิร์นนิ่งสามารถทำให้กิจกรรมการเรียนมีความสนุกสนาน (Mobile learning technologies can make learning activities fun)

☐ เทคโนโลยีโมบายเลิร์นนิ่งสามารถช่วยดึงดูดให้การสอนมีความน่าสนใจมากขึ้น (Mobile learning technologies can help make teaching more attractive)

☐ เทคโนโลยีโมบายเลิร์นนิ่งสามารถช่วยให้นักเรียนมีส่วนร่วมในกิจกรรมการเรียน (Mobile learning technologies can assist students to participate in learning activities)

☐ ข้อมูลเนื้อหาวิชาที่สอนสามารถนำมาผสมผสานกับการใช้โมบายเทคโนโลยีได้ (Contents of subject are match for using mobile technology)

☐ อื่นๆ (โปรดระบุ) (Other (please specify))……

2.7 ทำไมท่านคิดว่าเทคโนโลยีโมบายเลิร์นนิ่งไม่มีประโยชน์ต่อการสอนของท่าน (ตอบ 3 ข้อที่ท่านเห็นว่าสำคัญสุด) (Why do you think that mobile learning technology is not useful for teaching?

(Please tick three most important that apply))

☐ เสียเวลา (Waste of time)

☐ สูญเสียเงินและทรัพยากร (Waste of money and resources)

☐ สภาพแวดล้อมไม่เหมาะสม (Inappropriate environment)

☐ หลักสูตรไม่รองรับกับการใช้เทคโนโลยีโมบายเลิร์นนิ่ง (Curriculum is not supported)

☐ การพัฒนาของเทคโนโลยีที่รวดเร็ว (Technological development)

☐เทคโนโลยีโมบายเลิร์นนิ่งอาจมีส่วนทำให้เกิดการเสียสมาธิหรือไขว้เขวภายในห้องเรียน (Mobile learning technologies may contribute to distraction in classroom)

☐ อื่นๆ (โปรดระบุ) (Other (please specify))……

2.8 ท่านใช้เทคโนโลยีโมบายเลิร์นนิ่งช่วยในการสอนของท่านบ่อยแค่ไหน (How frequently have you utilised mobile technology to help you teach?)

☐ บ่อย (Frequently) ☐ นานๆครั้ง (Rarely)

☐ บางครั้งบางคราว (Occasionally) ☐ ไม่เคย (None)

2.9 ท่านชอบใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอนหรือไม่ (Do you like using mobile learning technologies for teaching?)

☐ ชอบ (Yes) ☐ ไม่ชอบ (No)

2.10จากข้อความในตารางโปรดเลือกระดับความคิดเห็นที่ถูกต้องต่อความคิดเห็นของท่านมากที่สุดเมื่อใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอน (What is your opinion on the validity of the following statements when using mobile learning technology for teaching?)

กรุณาทำเครื่องหมาย ✓ ลงในช่องที่ตรงกับความคิดเห็นของท่านมากที่สุด (Please tick the answer you think most appropriate with statement below)

ความคิดเห็นต่อการใช้เทคโนโลยีโมบายเลิร์นนิ่ง (Statements on your opinion to not like using mobile learning technology)	**ระดับความคิดเห็น**				
	Strongly Disagree **ไม่เห็นด้วยอย่างยิ่ง**	Disagree **ไม่เห็นด้วย**	Neither **ปานกลาง**	Agree **เห็นด้วย**	Strongly Agree **เห็นด้วยอย่างยิ่ง**
1. การเชื่อมต่อสัญญาณอินเทอร์เน็ตแย่หรือเชื่อมต่อไม่ได้ (Poor or no internet connection)					
2. จำนวนเครื่องมือหรืออุปกรณ์ไม่เพียงพอ (Number of devices are not enough)					
3. ครูผู้สอนขาดประสบการณ์ในการใช้โมบายเทคโนโลยี(Teachers lack the experience of using mobile technology)					
4. ขาดความเชี่ยวชาญและวิธีการใช้งานโมบายเทคโนโลยีในการสอน(There is a lack of expert to teach how to use of mobile technology)					
5. ข้อจำกัดในการใช้งานของโมบายเทคโนโลยี (Mobile technologies have limited use)					

ความคิดเห็นต่อการใช้เทคโนโลยีโมบายเลิร์นนิ่ง (Statements on your opinion to not like using mobile learning technology)	**ระดับความคิดเห็น**				
	Strongly Disagree **ไม่เห็นด้วยอย่างยิ่ง**	Disagree **ไม่เห็นด้วย**	Neither **ปานกลาง**	Agree **เห็นด้วย**	Strongly Agree **เห็นด้วยอย่างยิ่ง**
6. ความซับซ้อนของโมบายเทคโนโลยี ทำให้ยากต่อการใช้ในการสอน (Mobile technologies are very complex)					
7. เสียเวลาในการเตรียมข้อมูลสำหรับการใช้โมบายเทคโนโลยีในการสอน (Preparing contents for Mobile Technology is a waste time)					
8. การออกแบบลักษณะลูกเล่น(Features)ของโมบายเทคโนโลยีที่แย่ (Poor design of technologies features)					

3. ท่านพบว่าเทคโนโลยีโมบายเลิร์นนิ่งมีประสิทธิภาพในการสนับสนุนการสอนของท่านในห้องเรียนหรือไม่ (Did you find mobile technology effective in supporting your teaching in class?)

☐ ใช่ (Yes) ☐ ไม่ใช่ (No)

4. ท่านพบว่าเทคโนโลยีโมบายเลิร์นนิ่งมีประสิทธิภาพในการสนับสนุนการสอนของท่านนอกห้องเรียนอย่างไร (How did you find mobile technology effective in supporting you to teach outside of the classroom?)

☐ นักเรียนสามารถทบทวนบทเรียนได้ด้วยตัวเอง (Students can review lesson by themselves)

☐ เพิ่มช่องทางการติดต่อสื่อสารกันระหว่างนักเรียนและครู (Increases communication between student and teacher)

☐ อื่นๆ (โปรดระบุ) (Others (please specify))……

5.ท่านคิดว่าเทคโนโลยีโมบายเลิร์นนิ่งเป็นสื่อการสอนสำคัญที่ช่วยให้นักเรียนมีความเข้าใจมากขึ้น (How significant is mobile technology in aiding students understanding teaching materials?)

บนเลขสเกล 1-5: (1) อ่อน, (2) พอใช้, (3) ดี, (4) ดีมาก และ (5) ดีเยี่ยม กรุณาวงกลม ❍ ลงบนตัวเลขที่ตรงกับความคิดเห็นของท่านมากที่สุด

1: อ่อน 2: พอใช้ 3: ดี 4: ดีมาก 5: ดีเยี่ยม

(On a scale of 1-5: (1) poor, (2) fair, (3) good, (4) very good and (5) excellent please circle the number to complete for this question.)

1 2 3 4 5

6.ท่านคิดว่าปัจจัยใดสำคัญที่สุดเมื่อท่านเลือกใช้เทคโนโลยีโมบายเลิร์นนิ่งสำหรับการสอนของท่าน (What is the most important factor of the following statements when choosing your mobile learning technology for teaching?)

กรุณาวงกลม ❍ ลงบนตัวเลขที่ตรงกับความคิดเห็นของท่านมากที่สุด
บนสเกล 1-5: (1) ไม่สำคัญ, (2) ค่อนข้างสำคัญ, (3) สำคัญ (4) สำคัญมาก และ (5) สำคัญอย่างยิ่ง

(Please circle the rate you think most appropriate with the following statement below. On Scale of 1 – 5: (1) Not important, (2) Neither Important nor Unimportant, (3) Important, (4) Very Important and (5) Extremely Important)

Statements on the important factor of using mobile learning technology **ปัจจัยสำคัญในการใช้เทคโนโลยีการเรียนรู้บนมือถือ**					
1. เหมาะสมกับวิชาที่สอน (Suitable for subject area)	1	2	3	4	5
2. ทำให้สะดวกหรือง่ายขึ้น (Facilitate)	1	2	3	4	5
3. ลดระยะเวลาในการสอน (Reduce time to teach)	1	2	3	4	5
4. ให้โอกาสในการศึกษาเรียนรู้ (Provide educational opportunities for learning)	1	2	3	4	5
5. เทคโนโลยีโมบายเลิร์นนิ่งสามารถทำให้สื่อการสอนมีความน่าสนใจและเข้าใจง่าย (Mobile learning technology can make materials interesting and easy to understand)	1	2	3	4	5
6. เทคโนโลยีโมบายเลิร์นนิ่งมีความสะดวก (Mobile learning technologies are convenient)	1	2	3	4	5

7. ท่านมีความคิดเห็นอย่างไรเมื่อใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอน (How did you find teaching using mobile technology?)

บนสเกล 1-5 (5) ยอดเยี่ยม/สูง/ง่าย และ (1) แย่/ต่ำ/ยาก กรุณาวงกลม ❍ ลงบนตัวเลขที่ตรงกับความคิดเห็นของท่านมากที่สุด

(On a scale of 1-5 with 5 being excellent/high/easy and 1 being poor/low/difficult, Please circle the number to complete for this question.)

1 2 3 4 5

8. ท่านต้องการให้มีสื่อการสอนอื่นๆเพิ่มบนโมบายเทคโนโลยีหรือไม่ (Would you like to have more teaching materials available on mobile technologies?)

☐ ต้องการ (Yes) ☐ ไม่ต้องการ (No)

9.ท่านต้องการที่จะมีปฏิสัมพันธ์กับผู้เรียนผ่านเทคโนโลยีโมบายเลิร์นนิ่งโดยเชื่อมโยงให้เข้ากับหลักสูตรหรือไม่ (Would like to be able to interact with your learner via mobile learning technology regarding concerns related to the curriculum?)

☐ ต้องการ (Yes) ☐ ไม่ต้องการ (No)

10. ท่านมีทัศนคติอย่างไรต่อการใช้โมบายเทคโนโลยีในการสอน (What is your attitude towards the use of mobile technology in teaching?)

☐ เชิงลบ (Negative) ☐ กลางๆ (Neutral) ☐ เชิงบวก (Positive)

11. ข้อเสนอแนะอื่นๆเกี่ยวกับการใช้โมบายเทคโนโลยีในการสอน (Please state any further comments about using mobile technology for teaching?)

……

……

……

ขอบคุณทุกท่านที่ให้ความร่วมมือในการตอบแบบสอบถาม

Thank you for completing this questionnaire

Appendix C: SPSS Descriptive Statistics Calculations

Position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Executive of school	52	16.1	16.1	16.1
	Teacher	270	83.9	83.9	100.0
	Total	322	100.0	100.0	

Location of school

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Urban	167	51.9	51.9	51.9
	Rural	155	48.1	48.1	100.0
	Total	322	100.0	100.0	

Do you have any experience in using mobile technology in education?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	205	63.7	63.7	63.7
	No	117	36.3	36.3	100.0
	Total	322	100.0	100.0	

Location of school * Do you have any experience in using mobile technology in education? Crosstabulation

Count

		Do you have any experience in using mobile technology in education?		
		Yes	No	Total
Location of school	Urban	113	54	167
	Rural	92	63	155
Total		205	117	322

Which of the following factors do you think could be the reason for your lack of use of mobile technology in education?

		Frequency	Percent	Valid Percent
Valid	Lack of guidance and training	55	17.1	47.0
	Remote distance	7	2.2	6.0
	Lack of support from leadership	3	.9	2.6
	School not ready for mobile technology	51	15.8	43.6
	Others	1	.3	.9
	Total	117	36.3	100.0
Missing	9	205	63.7	
Total		322	100.0	

For teaching which academic subjects do you use mobile technology?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Mathematics	67	20.8	32.7	32.7
	English Language	52	16.1	25.4	58.0
	Sciences	43	13.4	21.0	79.0
	Others	43	13.4	21.0	100.0
	Total	205	63.7	100.0	
Missing	9	117	36.3		
Total		322	100.0		

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
For teaching which academic subjects do you use mobile technology? * Electronics Books_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Video_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Pictures_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Sound_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Multimedia_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you	206	64.0%	116	36.0%	322	100.0%

use mobile technology? * Animation_What features/applications of mobile technology do you use for teaching?						
For teaching which academic subjects do you use mobile technology? * Work Class Exercise_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Audio Clips_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Reading Content_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Activity_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Review/Practice_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? *	206	64.0%	116	36.0%	322	100.0%

Quiz_What features/applications of mobile technology do you use for teaching?						
For teaching which academic subjects do you use mobile technology? * Simulation_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Games_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%
For teaching which academic subjects do you use mobile technology? * Others_What features/applications of mobile technology do you use for teaching?	206	64.0%	116	36.0%	322	100.0%

Crosstab

Count

		Electronics Books_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	20	46	66
	English Language	13	39	52
	Sciences	11	32	43
	Others	17	27	44
	12	0	1	1
Total		61	145	206

Crosstab

Count

		Video_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	17	49	66
	English Language	17	35	52
	Sciences	7	36	43
	Others	10	34	44
	12	0	1	1
Total		51	155	206

Crosstab

Count

		Pictures_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	39	27	66
	English Language	29	23	52
	Sciences	27	16	43
	Others	29	15	44
	12	1	0	1
Total		125	81	206

Crosstab

Count

		Sound_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	11	55	66
	English Language	14	38	52
	Sciences	6	37	43
	Others	11	33	44
	12	0	1	1
Total		42	164	206

Crosstab

Count

		Multimedia_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	24	42	66
	English Language	21	31	52
	Sciences	16	27	43
	Others	13	31	44
	12	0	1	1
Total		74	132	206

Crosstab

Count

		Animation_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	25	41	66
	English Language	11	41	52
	Sciences	17	26	43
	Others	31	13	44
	12	0	1	1
Total		84	122	206

Crosstab

Count

		Work Class Exercise_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	33	33	66
	English Language	14	38	52
	Sciences	7	36	43
	Others	12	32	44
	12	1	0	1
Total		67	139	206

Crosstab

Count

		Audio Clips_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	6	60	66
	English Language	5	47	52
	Sciences	2	41	43
	Others	14	30	44
	12	0	1	1
Total		27	179	206

Crosstab

Count

		Reading Content_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	6	60	66
	English Language	8	44	52
	Sciences	3	40	43
	Others	10	34	44
	12	0	1	1
Total		27	179	206

Crosstab

Count

		Activity_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	23	43	66
	English Language	20	32	52
	Sciences	10	33	43
	Others	7	37	44
	12	1	0	1
Total		61	145	206

Crosstab

Count

		Review/Practice_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	34	32	66
	English Language	19	33	52
	Sciences	18	25	43
	Others	22	22	44
	12	0	1	1
Total		93	113	206

Crosstab

Count

		Quiz_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	34	32	66
	English Language	16	36	52
	Sciences	14	29	43
	Others	14	30	44
	12	1	0	1
Total		79	127	206

Crosstab

Count

		Simulation_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	6	60	66
	English Language	8	44	52
	Sciences	9	34	43
	Others	5	39	44
	12	0	1	1
Total		28	178	206

Crosstab

Count

		Games What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	22	44	66
	English Language	16	36	52
	Sciences	18	25	43
	Others	20	24	44
	12	0	1	1
Total		76	130	206

Crosstab

Count

		Others_What features/applications of mobile technology do you use for teaching?		
		Yes	No	Total
For teaching which academic subjects do you use mobile technology?	Mathematics	1	65	66
	English Language	1	51	52
	Sciences	0	43	43
	Others	1	43	44
	12	0	1	1
Total		3	203	206

Do you think mobile technology is useful for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	295	91.6	91.6	91.6
	No	27	8.4	8.4	100.0
	Total	322	100.0	100.0	

Statistics

		Mobile learning technologies can improve the effectiveness of teaching Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply	Mobile learning technologies can improve pupil's engagement and interaction Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply	Mobile learning technologies can improve pupil's enthusiasm Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply	Mobile learning technologies can motivate students to study Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply	Mobile learning technologies can make learning activities fun Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply	Mobile learning technologies can help make teaching more attractive Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply	Mobile learning technologies can assist students to participate in learning activities Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply	Contents of subject are match for using mobile technology Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply	Others Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply
N	Valid	322	322	322	322	322	322	322	322	322
	Missing	0	0	0	0	0	0	0	0	0
Mean		1.48	1.62	1.35	1.56	1.77	1.77	1.82	1.91	2.00
Median		1.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00
Mode		1	2	1	2	2	2	2	2	2
Std. Deviation		.500	.487	.477	.497	.419	.423	.387	.282	.000
Sum		476	521	434	502	571	569	585	616	644

Mobile learning technologies can improve the effectiveness of teaching_Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	168	52.2	52.2	52.2
	No	154	47.8	47.8	100.0
	Total	322	100.0	100.0	

Mobile learning technologies can improve pupil's engagement and interaction_Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	123	38.2	38.2	38.2
	No	199	61.8	61.8	100.0
	Total	322	100.0	100.0	

Mobile learning technologies can improve pupil's enthusiasm_Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	210	65.2	65.2	65.2
	No	112	34.8	34.8	100.0
	Total	322	100.0	100.0	

Mobile learning technologies can motivate students to study_Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	142	44.1	44.1	44.1
	No	180	55.9	55.9	100.0
	Total	322	100.0	100.0	

Mobile learning technologies can make learning activities fun_Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	73	22.7	22.7	22.7
	No	249	77.3	77.3	100.0
	Total	322	100.0	100.0	

Mobile learning technologies can help make teaching more attractive_Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	75	23.3	23.3	23.3
	No	247	76.7	76.7	100.0
	Total	322	100.0	100.0	

Contents of subject are match for using mobile technology_Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	28	8.7	8.7	8.7
	No	294	91.3	91.3	100.0
	Total	322	100.0	100.0	

Others_Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	322	100.0	100.0	100.0

Statistics

		Waste of time Why do you think that mobile learning technology is not useful for teaching?	Waste of money and resources Why do you think that mobile learning technology is not useful for teaching?	Inappropriate environment Why do you think that mobile learning technology is not useful for teaching?	Curriculum is not supported Why do you think that mobile learning technology is not useful for teaching?	Technological development Why do you think that mobile learning technology is not useful for teaching?	Mobile learning technologies may contribute to distraction in classroom Why do you think that mobile learning technology is not useful for teaching?	Others Why do you think that mobile learning technology is not useful for teaching?
N	Valid	322	322	322	322	322	322	322
	Missing	0	0	0	0	0	0	0
Mean		1.99	1.98	1.93	1.96	1.98	1.95	1.98
Median		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Mode		2	2	2	2	2	2	2
Std. Deviation		.111	.156	.247	.197	.156	.211	.135
Sum		640	636	623	631	636	629	638

Waste of time Why do you think that mobile learning technology is not useful for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	4	1.2	1.2	1.2
	No	318	98.8	98.8	100.0
	Total	322	100.0	100.0	

Waste of money and resources Why do you think that mobile learning technology is not useful for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	2.5	2.5	2.5
	No	314	97.5	97.5	100.0
	Total	322	100.0	100.0	

Inappropriate environment Why do you think that mobile learning technology is not useful for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	21	6.5	6.5	6.5
	No	301	93.5	93.5	100.0
	Total	322	100.0	100.0	

Curriculum is not supported Why do you think that mobile learning technology is not useful for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	13	4.0	4.0	4.0
	No	309	96.0	96.0	100.0
	Total	322	100.0	100.0	

Technological development Why do you think that mobile learning technology is not useful for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	2.5	2.5	2.5
	No	314	97.5	97.5	100.0
	Total	322	100.0	100.0	

Mobile learning technologies may contribute to distraction in classroom_Why do you think that mobile learning technology is not useful for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	15	4.7	4.7	4.7
	No	307	95.3	95.3	100.0
	Total	322	100.0	100.0	

Others_Why do you think that mobile learning technology is not useful for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	6	1.9	1.9	1.9
	No	316	98.1	98.1	100.0
	Total	322	100.0	100.0	

Statistics

How frequently have you utilised mobile technology to help you teach?

N	Valid	322
	Missing	0
Mean		2.41
Median		2.00
Mode		2
Std. Deviation		1.044
Sum		777

How frequently have you utilised mobile technology to help you teach?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Frequently	68	21.1	21.1	21.1
	Occasionally	121	37.6	37.6	58.7
	Rarely	65	20.2	20.2	78.9
	None	68	21.1	21.1	100.0
	Total	322	100.0	100.0	

Do you like using mobile learning technologies for teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	269	83.5	83.5	83.5
	No	53	16.5	16.5	100.0
	Total	322	100.0	100.0	

Statistics

		Poor or no internet connection	Number of devices are not enough	Teachers lack the experience of using mobile technology	There is a lack of expert to teach how to use of mobile technology	Mobile technologies have limited use	Mobile technologies are very complex	Preparing contents for Mobile Technology is a waste time	Poor design of technologies features
N	Valid	322	322	322	322	322	322	322	322
	Missing	0	0	0	0	0	0	0	0
Mean		3.47	3.52	3.42	3.53	3.30	3.17	2.76	2.80
Median		4.00	4.00	4.00	4.00	3.00	3.00	3.00	3.00
Mode		4	4	4	4	3	3	3	3
Std. Deviation		1.035	1.097	.941	1.038	.869	.919	.905	.776
Sum		1116	1132	1100	1138	1064	1020	888	902

Poor or no internet connection

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	17	5.3	5.3	5.3
	Disagree	31	9.6	9.6	14.9
	Neither	109	33.9	33.9	48.8
	Agree	115	35.7	35.7	84.5
	Strongly Agree	50	15.5	15.5	100.0
	Total	322	100.0	100.0	

Number of devices are not enough

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	19	5.9	5.9	5.9
	Disagree	35	10.9	10.9	16.8
	Neither	90	28.0	28.0	44.7
	Agree	117	36.3	36.3	81.1
	Strongly Agree	61	18.9	18.9	100.0
	Total	322	100.0	100.0	

Teachers lack the experience of using mobile technology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	9	2.8	2.8	2.8
	Disagree	44	13.7	13.7	16.5
	Neither	105	32.6	32.6	49.1
	Agree	132	41.0	41.0	90.1
	Strongly Agree	32	9.9	9.9	100.0
	Total	322	100.0	100.0	

There is a lack of expert to teach how to use of mobile technology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	18	5.6	5.6	5.6
	Disagree	25	7.8	7.8	13.4
	Neither	100	31.1	31.1	44.4
	Agree	125	38.8	38.8	83.2
	Strongly Agree	54	16.8	16.8	100.0
	Total	322	100.0	100.0	

Mobile technologies have limited use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	5	1.6	1.6	1.6
	Disagree	51	15.8	15.8	17.4
	Neither	128	39.8	39.8	57.1
	Agree	117	36.3	36.3	93.5
	Strongly Agree	21	6.5	6.5	100.0
	Total	322	100.0	100.0	

Mobile technologies are very complex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	11	3.4	3.4	3.4
	Disagree	59	18.3	18.3	21.7
	Neither	138	42.9	42.9	64.6
	Agree	93	28.9	28.9	93.5
	Strongly Agree	21	6.5	6.5	100.0
	Total	322	100.0	100.0	

Preparing contents for Mobile Technology is a waste time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	22	6.8	6.8	6.8
	Disagree	107	33.2	33.2	40.1
	Neither	127	39.4	39.4	79.5
	Agree	59	18.3	18.3	97.8
	Strongly Agree	7	2.2	2.2	100.0
	Total	322	100.0	100.0	

Poor design of technologies features

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	12	3.7	3.7	3.7
	Disagree	97	30.1	30.1	33.9
	Neither	158	49.1	49.1	82.9
	Agree	53	16.5	16.5	99.4
	Strongly Agree	2	.6	.6	100.0
	Total	322	100.0	100.0	

Did you find mobile technology effective in supporting your teaching in class?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	289	89.8	89.8	89.8
	No	33	10.2	10.2	100.0
	Total	322	100.0	100.0	

How did you find mobile technology effective in supporting you to teach outside of the classroom?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Students can review lesson by themselves	201	62.4	62.4	62.4
	Increases communication between student and teacher	109	33.9	33.9	96.3
	Others	12	3.7	3.7	100.0
	Total	322	100.0	100.0	

Did you find mobile technology effective in supporting your teaching in class? * How did you find mobile technology effective in supporting you to teach outside of the classroom? Crosstabulation

Count

		How did you find mobile technology effective in supporting you to teach outside of the classroom?			
		Students can review lesson by themselves	Increases communication between student and teacher	Others	Total
Did you find mobile technology effective in supporting your teaching in class?	Yes	187	97	5	289
	No	14	12	7	33
Total		201	109	12	322

How significant is mobile technology in aiding students understanding teaching materials?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	2	.6	.6	.6
	Fair	32	9.9	9.9	10.6
	Good	127	39.4	39.4	50.0
	Very Good	139	43.2	43.2	93.2
	Excellent	22	6.8	6.8	100.0
	Total	322	100.0	100.0	

Statistics

		Suitable for subject area	Facilitate	Reduce time to teach	Provide educational opportunities for learning	Mobile learning technology can make materials interesting and easy to understand	Mobile learning technologies are convenient
N	Valid	322	322	322	322	321	322
	Missing	0	0	0	0	1	0
Mean		3.47	3.56	3.36	3.74	3.78	3.60
Std. Deviation		.954	.892	.865	.894	.918	.874
Sum		1117	1146	1082	1203	1212	1160

Suitable for subject area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	6	1.9	1.9	1.9
	Neither Important nor Unimportant	36	11.2	11.2	13.0
	Important	133	41.3	41.3	54.3
	Very Important	95	29.5	29.5	83.9
	Extremely Important	52	16.1	16.1	100.0
	Total	322	100.0	100.0	

Facilitate

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	5	1.6	1.6	1.6
	Neither Important nor Unimportant	29	9.0	9.0	10.6
	Important	113	35.1	35.1	45.7
	Very Important	131	40.7	40.7	86.3
	Extremely Important	44	13.7	13.7	100.0
	Total	322	100.0	100.0	

Reduce time to teach

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	6	1.9	1.9	1.9
	Neither Important nor Unimportant	36	11.2	11.2	13.0
	Important	145	45.0	45.0	58.1
	Very Important	106	32.9	32.9	91.0
	Extremely Important	29	9.0	9.0	100.0
	Total	322	100.0	100.0	

Provide educational opportunities for learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	5	1.6	1.6	1.6
	Neither Important nor Unimportant	19	5.9	5.9	7.5
	Important	95	29.5	29.5	37.0
	Very Important	140	43.5	43.5	80.4
	Extremely Important	63	19.6	19.6	100.0
	Total	322	100.0	100.0	

Mobile learning technology can make materials interesting and easy to understand

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	5	1.6	1.6	1.6
	Neither Important nor Unimportant	18	5.6	5.6	7.2
	Important	95	29.5	29.6	36.8
	Very Important	129	40.1	40.2	76.9
	Extremely Important	74	23.0	23.1	100.0
	Total	321	99.7	100.0	
Missing	System	1	.3		
Total		322	100.0		

Mobile learning technologies are convenient

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Important	5	1.6	1.6	1.6
	Neither Important nor Unimportant	25	7.8	7.8	9.3
	Important	107	33.2	33.2	42.5
	Very Important	141	43.8	43.8	86.3
	Extremely Important	44	13.7	13.7	100.0
	Total	322	100.0	100.0	

How did you find teaching using mobile technology?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	6	1.9	1.9	1.9
	Fair	18	5.6	5.6	7.5
	Good	131	40.7	40.7	48.1
	Very Good	110	34.2	34.2	82.3
	Excellent	57	17.7	17.7	100.0
	Total	322	100.0	100.0	

Would you like to have more teaching materials available on mobile technologies?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	294	91.3	91.3	91.3
	No	28	8.7	8.7	100.0
	Total	322	100.0	100.0	

Would like to be able to interact with your learner via mobile learning technology regarding concerns related to the curriculum?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	280	87.0	87.0	87.0
	No	42	13.0	13.0	100.0
	Total	322	100.0	100.0	

What is your attitude towards the use of mobile technology in teaching?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Negative	13	4.0	4.0	4.0
	Neutral	146	45.4	45.4	49.4
	Positive	163	50.6	50.6	100.0
	Total	322	100.0	100.0	

Please state any further comments about using mobile technology for teaching?

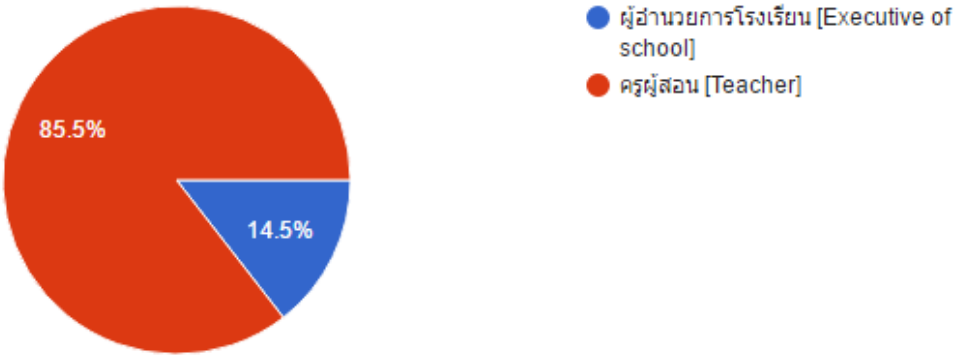
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		302	93.8	93.8	93.8
	students like to do something that the interested more than learn follow teacher teaching	1	.3	.3	94.1
	training before use	1	.3	.3	94.4
	can learn everywhere increase learning opportunity	1	.3	.3	94.7
	for primary level should not to use m-learning should to practice basic learning	1	.3	.3	95.0
	for teacher 50+ years old must training mobile learning technology usage in order to	1	.3	.3	95.3

develop contents to match our student in each age				
get more data, comfortable to search and reduce time	1	.3	.3	95.7
increase opportunity for every class of primary school	1	.3	.3	96.0
internet connection is weak so, teaching has threat(barrier)	1	.3	.3	96.3
internet signal has problem and limited usage	1	.3	.3	96.6
reduce time to search	2	.6	.6	97.2
school should take care about internet connection	1	.3	.3	97.5
shoud design innovation to encourage learing behaviour of students and have clearly guidebook	1	.3	.3	97.8
shoud support such as internet system in order to support mobile learning tech	1	.3	.3	98.1
Should adapt to easy to use, should have all subject, should have m-learning all curriculum	1	.3	.3	98.4
should encorage teacher and have training and guidance for teachers	1	.3	.3	98.8
should improve contents of chapter every year	1	.3	.3	99.1
should manage cover all chaper in order to comfortable for study and self learning	1	.3	.3	99.4
should support and buy it for every student	1	.3	.3	99.7
using technology to teach is good because student will be improve	1	.3	.3	100.0

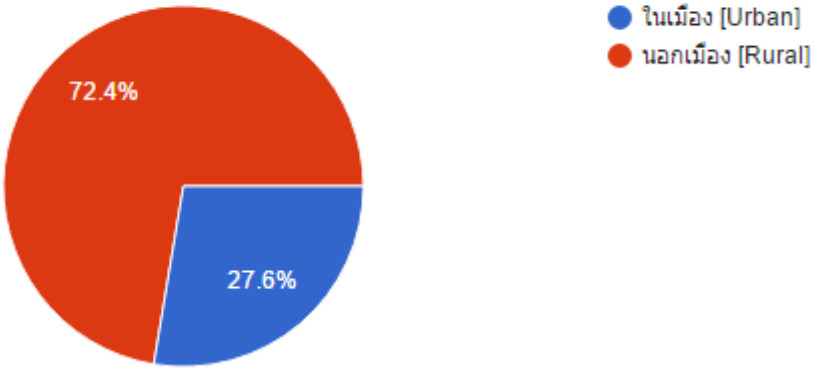
	enthusiasm(motivation) and more interesed than teaching by teachers but should selected in suitable time and subjects				
	Total	322	100.0	100.0	

Appendix D: Online Survey Results

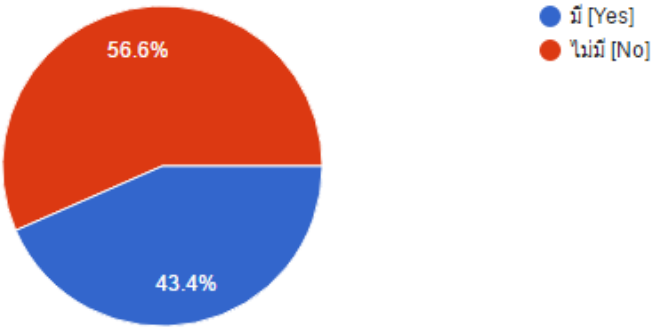
1.1 ตำแหน่ง [Position] (76 responses)



1.2 สถานที่ตั้งโรงเรียน [Location of your school] (76 responses)

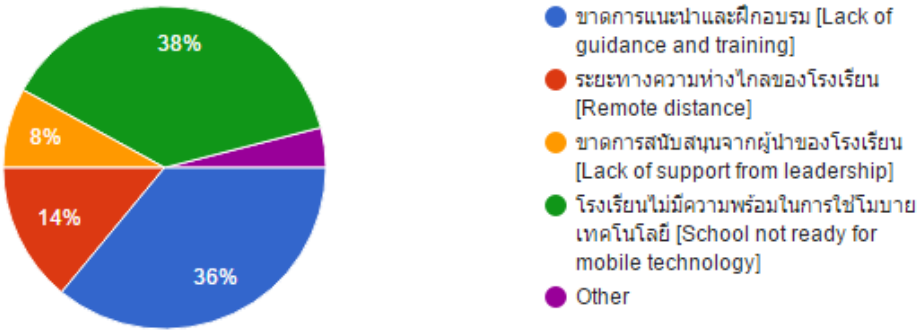


2.1 ท่านมีประสบการณ์ในการใช้เทคโนโลยีโมบายเลิร์นนิ่งในการเรียนการสอนหรือไม่ [Do you have any experience in using mobile learning technology in education?]
(76 responses)



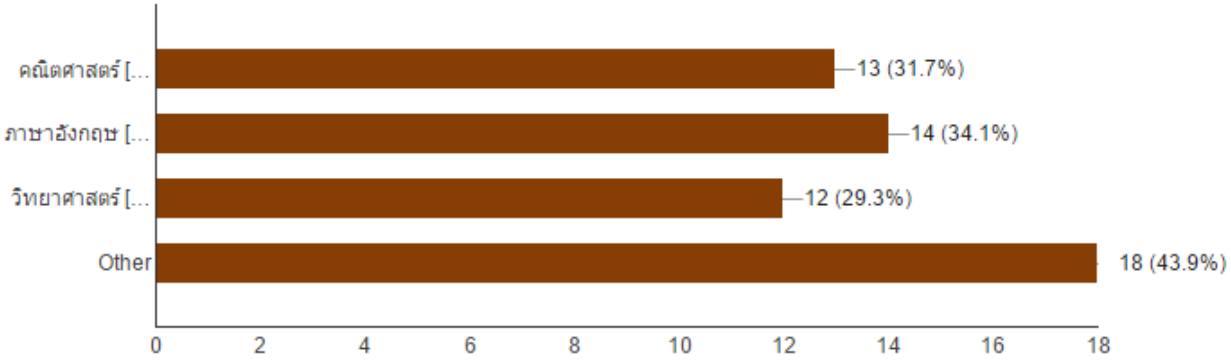
2.2 ท่านคิดว่าเหตุผลใดที่ทำให้ท่านขาดการใช้เทคโนโลยีโมบายเลิร์นนิ่งในการเรียนการสอน [Which of the following factors do you think could be the reason for your lack of use of mobile technology in education?]

(50 responses)



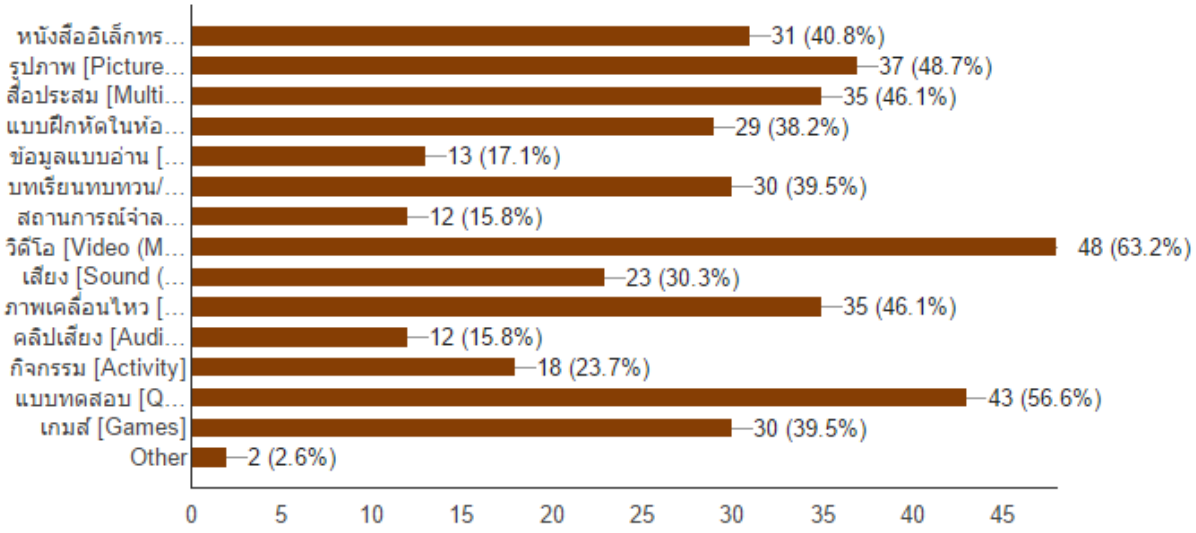
2.3 ท่านใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอนวิชาใด [For teaching which academic subjects do you use mobile technology?]

(41 responses)



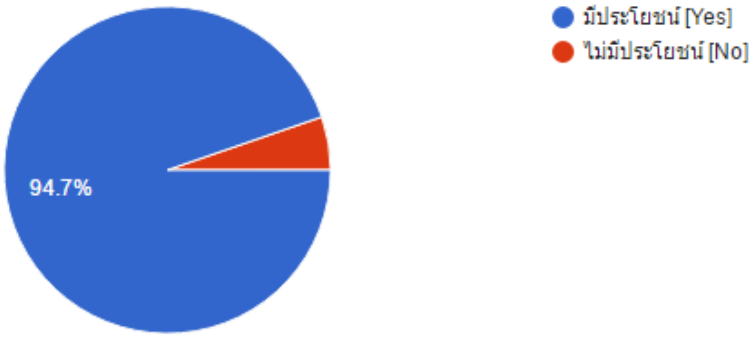
2.4 ลักษณะ (Features) หรือโปรแกรมประยุกต์ (Applications) แบบใดของเทคโนโลยีโมบายเลิร์นนิ่งที่ท่านใช้ในการสอน [What features/applications of mobile technology do you use for teaching?]

(76 responses)



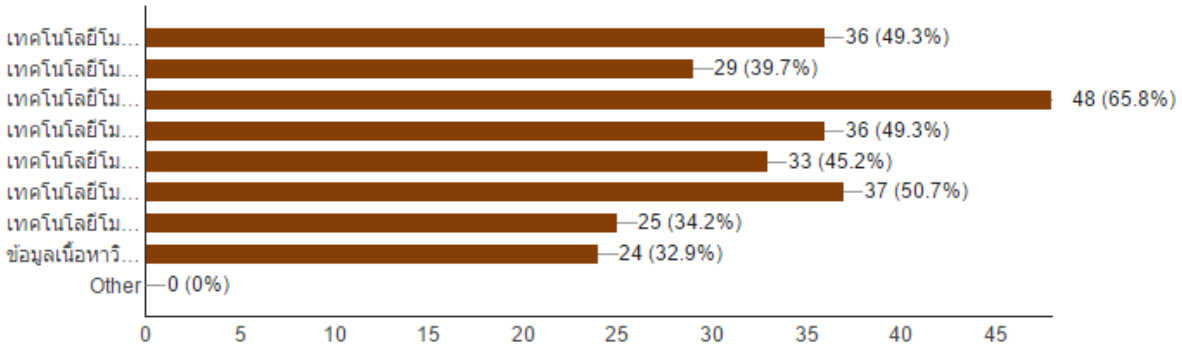
2.5 ท่านคิดว่าเทคโนโลยีโมบายเลิร์นนิ่งมีประโยชน์ต่อการสอนของท่านหรือไม่ [Do you think mobile technology is useful for teaching?]

(76 responses)



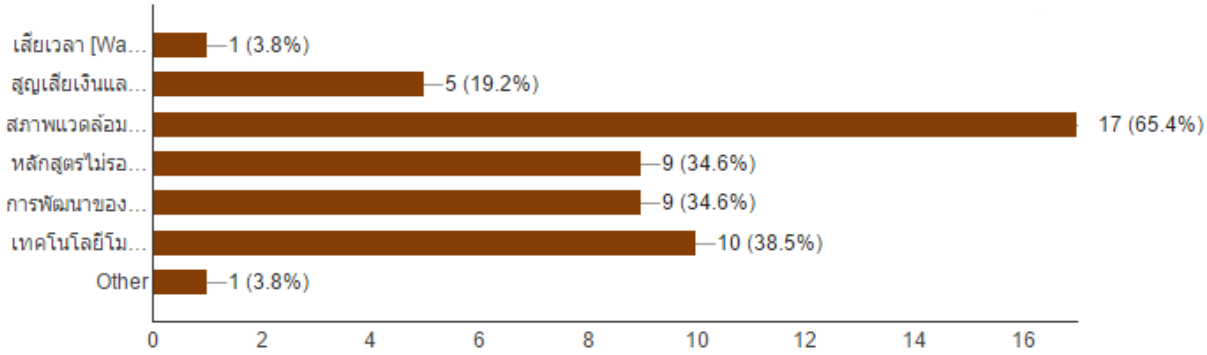
2.6 ทำไมท่านคิดว่าเทคโนโลยีโมบายเลิร์นนิ่งมีประโยชน์ต่อการสอนของท่าน (ตอบได้ 3 ข้อที่ท่านเห็นว่าสำคัญสุด) [Why do you think that mobile learning technology is useful for teaching? (Please tick three most important that apply)]

(73 responses)

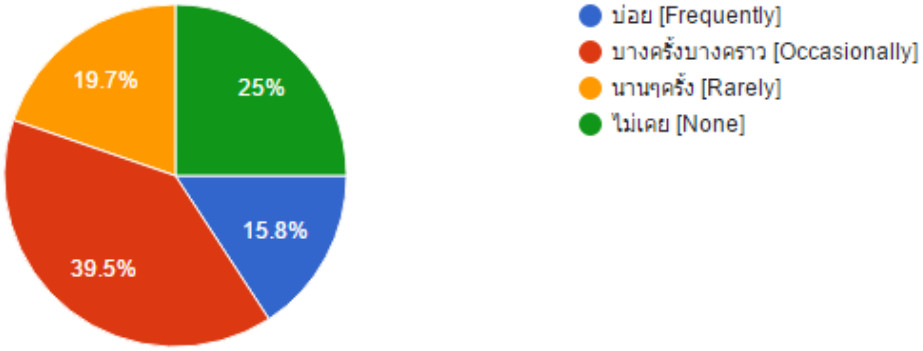


2.7 ทำไมท่านคิดว่าเทคโนโลยีโมบายเลิร์นนิ่งไม่มีประโยชน์ต่อการสอนของท่าน (ตอบได้ 3 ข้อที่ท่านเห็นว่าสำคัญสุด) [Why do you think that mobile learning technology is not useful for teaching? (Please tick the three most important that apply)]

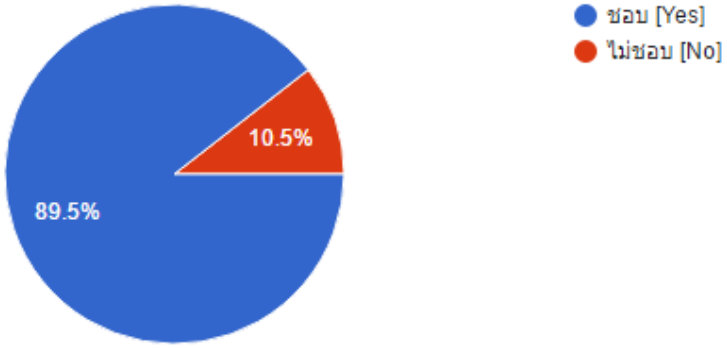
(26 responses)



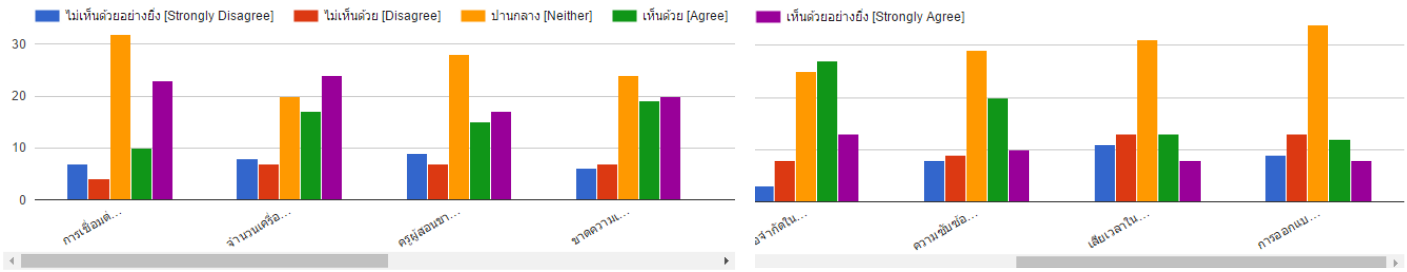
2.8 ท่านใช้เทคโนโลยีโมบายเลิร์นนิ่งช่วยในการสอนของท่านบ่อยแค่ไหน [How frequently have you utilised mobile technology to help you teach?]
(76 responses)



2.9 ท่านชอบใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอนหรือไม่ [Do you like using mobile learning technologies for teaching?]
(76 responses)

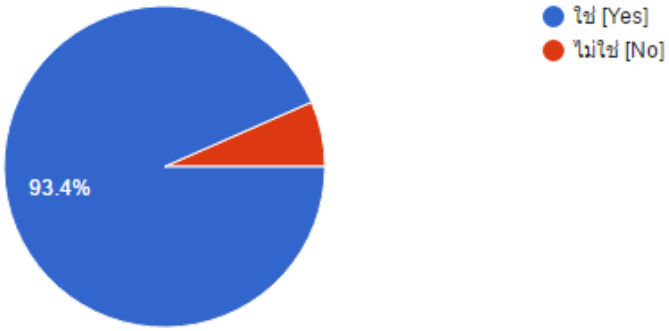


2.10 จากข้อความโปรดเลือกระดับความคิดเห็นที่ถูกต้องต่อความคิดเห็นของท่านมากที่สุดเมื่อใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอน [What is your opinion on the validity of the following statements when using mobile learning technology for teaching?]



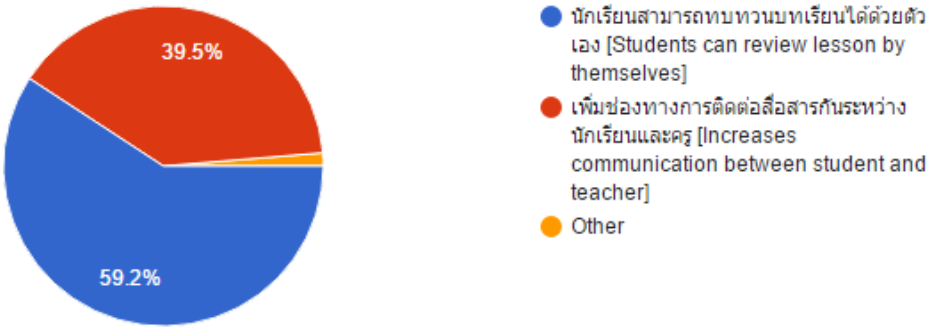
3. ท่านพบว่าเทคโนโลยีโมบายเลิร์นนิ่งมีประสิทธิภาพในการสนับสนุนการสอนของท่านในห้องเรียนหรือไม่ [Did you find mobile technology effective in supporting your teaching in class?]

(76 responses)



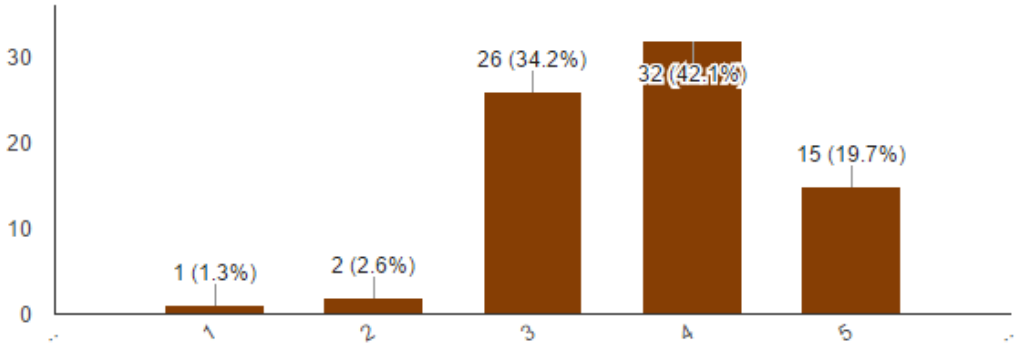
4. ท่านพบว่าเทคโนโลยีโมบายเลิร์นนิ่งมีประสิทธิภาพในการสนับสนุนการสอนของท่านนอกห้องเรียนหรือไม่อย่างไร [How did you find mobile technology effective in supporting you to teach outside of the classroom?]

(76 responses)

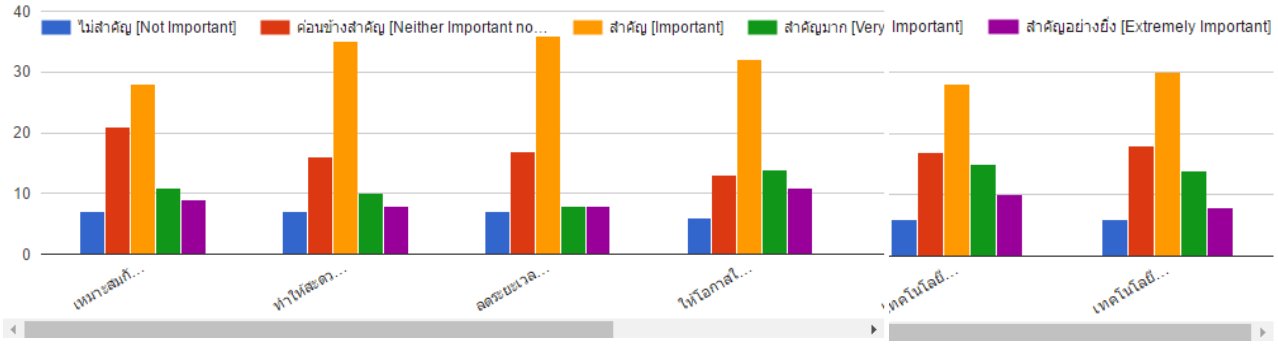


5. ท่านคิดว่าเทคโนโลยีโมบายเลิร์นนิ่งเป็นสื่อการสอนสำคัญที่ช่วยให้นักเรียนมีความเข้าใจมากขึ้น [How significant is mobile technology in aiding students understanding teaching materials?]

(76 responses)

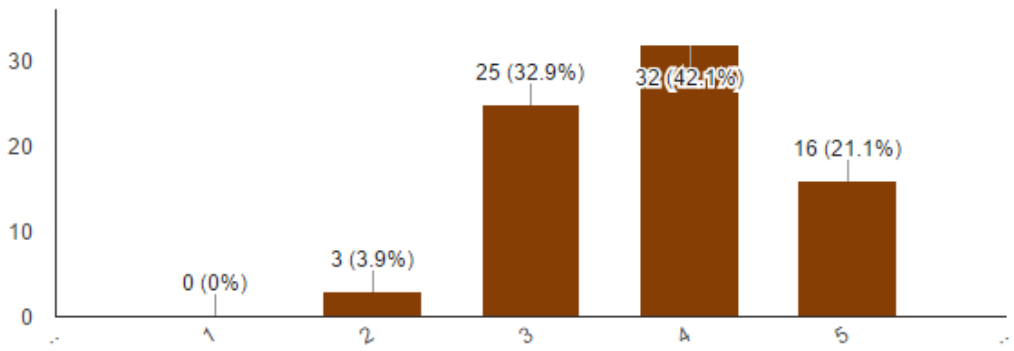


6. ท่านคิดว่าปัจจัยใดสำคัญที่สุดเมื่อท่านเลือกใช้เทคโนโลยีโมบายเลิร์นนิ่งสำหรับการสอนของท่าน [What is the most important factor of the following statements when choosing your mobile learning technology for teaching?]



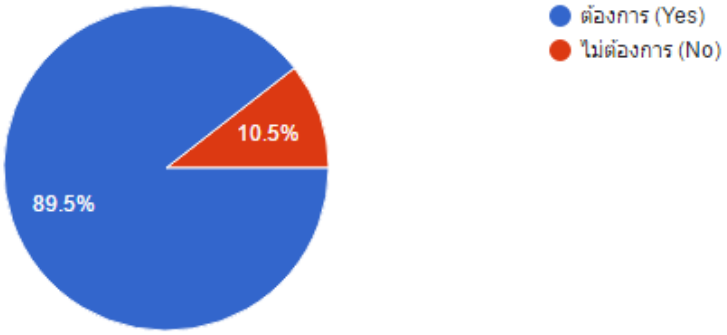
7. ท่านมีความคิดเห็นอย่างไรเมื่อใช้เทคโนโลยีโมบายเลิร์นนิ่งในการสอน [How did you find teaching using mobile technology?]

(76 responses)



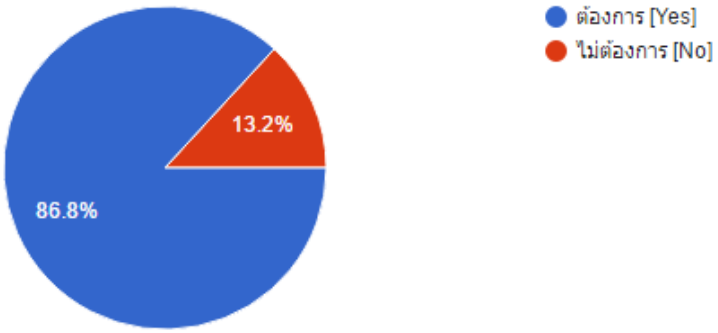
8. ท่านต้องการให้มีสื่อการสอนอื่นๆเพิ่มบนโมบายเทคโนโลยีหรือไม่ (Would you like to have more teaching materials available on mobile technologies?)

(76 responses)



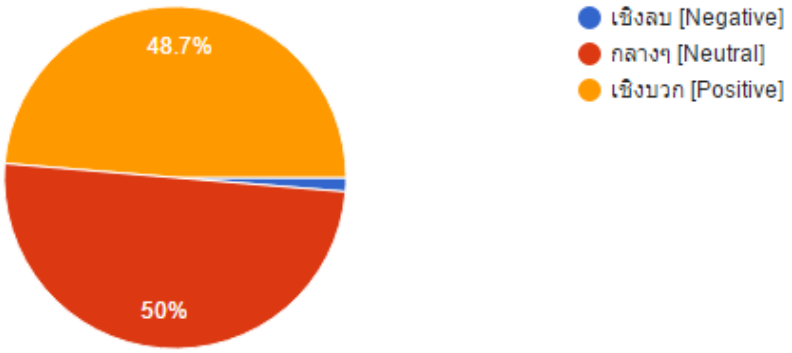
9. ท่านต้องการที่จะมีปฏิสัมพันธ์กับผู้เรียนผ่านเทคโนโลยีโมบายเลิร์นนิ่งโดยเชื่อมโยงให้เข้ากับหลักสูตรหรือไม่ [Would like to be able to interact with your learner via mobile learning technology regarding concerns related to the curriculum?]

(76 responses)



10. ท่านมีทัศนคติอย่างไรต่อการใช้โมบายเทคโนโลยีในการสอน [What is your attitude towards the use of mobile technology in teaching?]

(76 responses)



11. ข้อเสนอแนะอื่นๆเกี่ยวกับการใช้โมบายเทคโนโลยีในการสอน [Please state any further comments about using mobile technology for teaching?]

(13 responses)

ไม่มี
ไม่มี
-
-
เมนูการใช้งานต้องมีทั้งภาพและข้อความเพื่อให้ใช้ได้ทั้งคนที่อ่านหนังสือออกและไม่ออก
ประสิทธิภาพการใช้งานของอุปกรณ์ยังไม่เหมาะสม
ควรสอนให้นักเรียนรู้เท่าทันกับเทคโนโลยีที่นำมาใช้ในการสอน
จัดสรรงบซื้อสื่อเทคโนโลยีให้นักเรียนครบทุกคนและจัดงบประมาณดูแลสื่อ และจัดอบรมครูผู้สอนให้มีความรู้ความชำนาญในการใช้เทคโนโลยี
ครูผู้สอนต้องควบคุมการเรียนของนักเรียนเพราะสื่อสังคมออนไลน์ปัจจุบันเป็นสิ่งจูงใจให้ผู้เรียนไปสนใจมากกว่าบทเรียน
ไม่มีค่ะ
ขอบคุณที่ให้ความรู้ดีๆที่ได้เรียนรู้
นักเรียนสนใจสิ่งที่ควรรู้น้อยมาก. และไม่ค่อยใช้ในการหาความรู้. ส่วนมากชอบเล่นเกมส์.
อยากได้รับการอบรมเพื่อพัฒนาตนเอง

Appendix E: Semi-Structured Interviews Question (English Version)

List of Interview Questions

1. Introduction

This research aims to analyse the parameters associated with mobile technology enhanced teaching and then develop a novel decision support model to assist educators in determining appropriate mechanisms for utilising technology for teaching activities. The information you provide will be used to understand the use of mobile learning technology in elementary schools. Moreover, this research aims to analyse the use of mobile technology in learning and to develop a decision support model of mobile learning technology suitable for elementary schools.

2. Teacher perspective: set of interview questions:

1. What subjects/level do you teach?
2. Which features/applications of mobile learning technology do you currently use for teaching curriculum?
3. Why did you select the features/applications (answered in Q3 above) for teaching?
4. Which features/applications (answered in Q3 above) do you think are the most suitable for your subject?
5. Would you add any other features/applications to the ones already provide in Q3 above, that would make your subject easier?
6. What advantages do you see from using mobile learning technology?
7. If already to use, how effective is the mobile learning technologies in teaching your school?
8. What are the problems (if any) in using mobile learning technology for teaching?
9. What do you need before using mobile learning technology for teaching?
10. How would mobile learning technology help to improve the learner's experience?
11. Would teaching practice without mobile learning technology need to be any different from teaching with mobile learning technology?

12. Would curriculum design without mobile learning technology need to be any different from teaching with mobile learning technology?

3. Executive of school perspective: set of interview questions:

1. How would mobile learning technology be useful for teaching practice and delivering curriculum?
2. Do you use mobile technology at present in delivering the curriculum?
3. Could you please give an example of how mobile technology is used to support the curriculum?
4. Please outline how do you think mobile learning technology could support the delivery of curriculum in your school?

Thank you

Appendix F: Semi-Structured Interviews Question (Thai Version)

Teacher perspective: set of interview questions: **ส่วนที่ใช้สัมภาษณ์ครูผู้สอน**

1. คุณสอนวิชาอะไรและระดับชั้นไหน?
2. Which features/applications of mobile learning technology do you currently use for teaching curriculum? คุณใช้ Features/applications ไหนสำหรับการสอนที่ใช้ Mobile learning technology
3. Why did you select the features/applications (answered in Q3 above) for teaching? ทำไมคุณถึงเลือกใช้Features/applicationsนั้นในการสอน
4. Which features/applications (answered in Q3 above) do you think are the most suitable for your subject? Features/applicationsไหนที่คุณคิดว่าเหมาะสมกับวิชาที่คุณสอนมากที่สุด
5. Would you add any other features/applications to the ones already provide in Q3 above that would make your subject easier? **คุณต้องการเพิ่ม** Features/applications มั้ยจากข้อ 3 เพื่อให้การสอนในวิชาของคุณนั้นง่ายขึ้น
6. What advantages do you see from using mobile learning technology? คุณเห็นข้อดีอะไรจากการใช้ mobile learning technology
7. If already to use, how effective is the mobile learning technologies in teaching your school? คุณคิดอย่างไรเพื่อที่จะทำให้การใช้ mobile learning technology ในการสอนนั้นมีประสิทธิภาพสำหรับโรงเรียนของคุณ
8. What are the problems (if any) in using mobile learning technology for teaching? สิ่งที่เป็นปัญหาในการใช้ mobile learning technology สำหรับการสอน
9. What do you need before using mobile learning technology for teaching? คุณต้องการสิ่งใดหรือไม่ก่อนที่จะใช้ mobile learning technology สำหรับการสอนของท่าน
10. How would mobile learning technology help to improve the learner's experience? คุณคิดว่า Mobile learning technology ช่วยพัฒนาปรับปรุงประสบการณ์/ของผู้เรียนอย่างไร

11. Would teaching practice without mobile learning technology need to be any different from teaching with mobile learning technology? การเรียนการสอนแบบไม่มีเทคโนโลยีโมบายเลินนิ่ง มีความต้องการแตกต่างจากมีเทคโนโลยีโมบายเลินนิ่งมั้ย? มีกับไม่มี mobile learning technology มีความต้องการที่แตกต่างกันมั้ย
12. Would curriculum design without mobile learning technology need to be any different from teaching with mobile learning technology? การออกแบบหลักสูตรแบบไม่มี mobile learning technologyมีความต้องการแตกต่างจากมี mobile learning technologyมั้ย

***Executive of school perspective: set of interview questions:* ส่วนที่ใช้สัมภาษณ์ผู้อำนวยการ**

1. How would mobile learning technology be useful for teaching practice and delivering curriculum? การเรียนการสอนด้วย mobile learning technology มีประโยชน์สำหรับการสอนและดำเนินการหลักสูตรอย่างไร
2. Do you use mobile technology at present in delivering the curriculum? คุณใช้ mobile technologyในการดำเนินการหลักสูตรหรือไม่
3. Could you please give an example of how mobile technology is used to support the curriculum? ช่วยยกตัวอย่างวิธีการที่ทำอย่างไรที่จะใช้ mobile technology ในการสนับสนุนหลักสูตรของท่าน
4. Please outline how do you think mobile learning technology could support the delivery of curriculum in your school? คุณคิดว่าการเรียนด้วย mobile learning technologyจะสามารถรองรับและช่วยสนับสนุนและดำเนินงานหลักสูตรในโรงเรียนของคุณหรือไม่

ขอขอบคุณในความร่วมมือในการสัมภาษณ์

Appendix G Consent Form for Interview

LIVERPOOL JOHN MOORES UNIVERSITY

CONSENT FORM

To be translated into Thai and language checked by a language academic from Naresuan University

Title of Project: A decision support model for mobile technology enhanced teaching

Name of Researcher and School/Faculty: Suparawadee Trongtortam (Department of computer science Faculty of Technology and Environment)

1. I confirm that I have read and understand the information provided for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights. ☐
3. I understand that any personal information collected during the study will be anonymised and remain confidential ☐
4. I agree to take part in the above study *(Interview)* ☐

For studies involving the use of audio / video recording of interviews, focus groups etc or where there is a possibility that verbatim quotes from participants may be used in future publications or presentations please include the following:

5. I understand that the interview will be audio recorded and I am happy to proceed ☐
6. I understand that parts of our conversation may be used verbatim in future publications or presentations but that such quotes will be anonymised. ☐

Name of Participant Date Signature

Name of Researcher Date Signature
Suparawadee Trongtortam

Name of Person taking consent Date Signature

(if different from researcher)

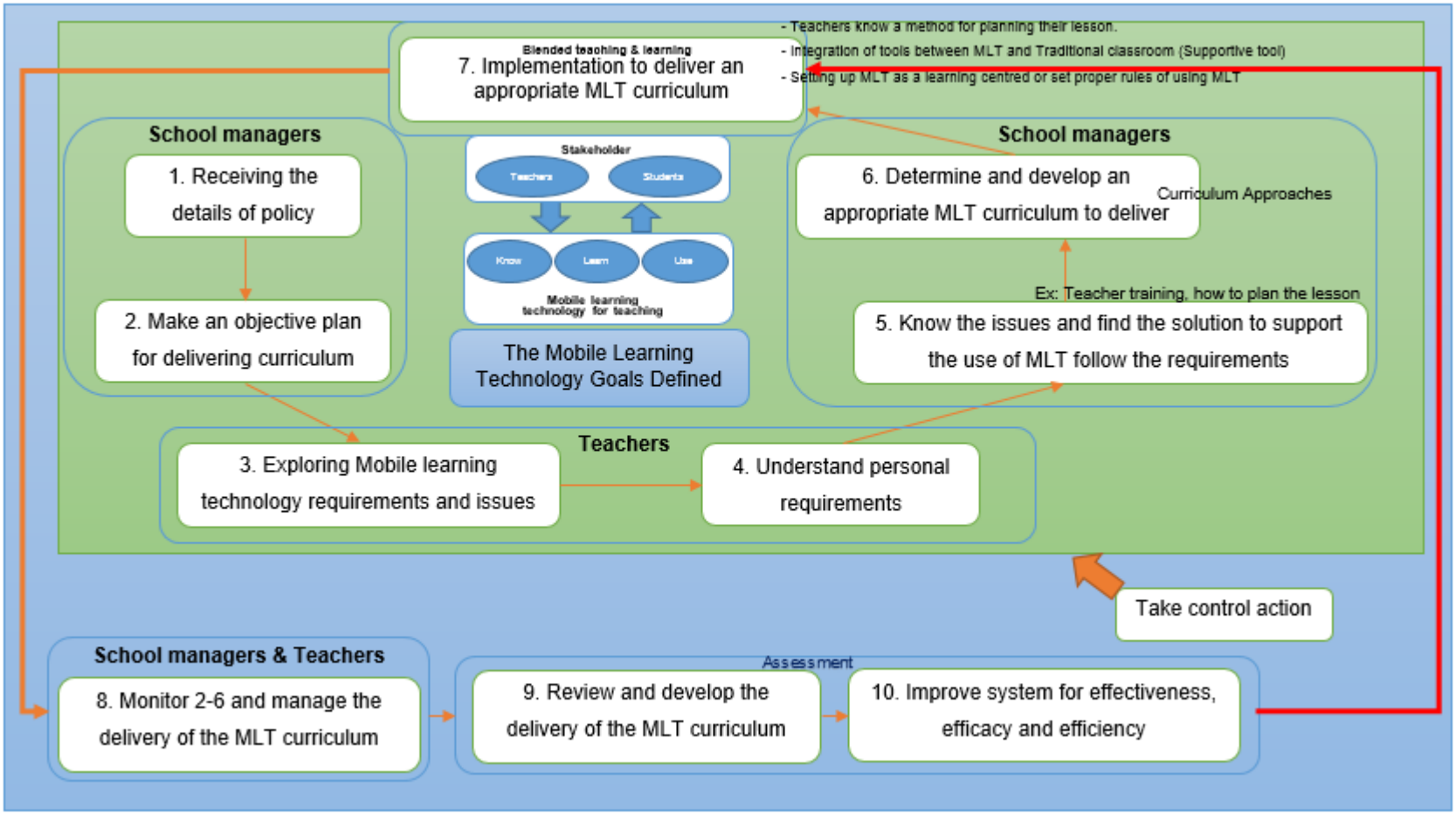
Note: When completed 1 copy for participant and 1 copy for researcher

Appendix H: Questionnaire of the evaluation on desire and feasible of decision support model of mobile learning technology (English Version)

Questionnaire of the evaluation on desire and feasible of decision support model of mobile learning technology

In order to test the desire and feasible of a decision support model, the questionnaire have to experimental curriculum method amongst educators and managers of education systems and report on its effectiveness in delivering curriculum in the context of primary school education.

The Decision Support Model of Mobile Learning Technology



Prior to evaluating, please see the above model and evaluate on the desirability and feasibility change of Decision Support Model of Mobile Learning Technology, we use rating scale to evaluate as the following:

1. Position

☐ Executive of school ☐ Teacher

2. Evaluate statement

On a scale of 1 to 5, how satisfied were you with the decision support model of mobile learning technology guide based on the following criteria:

Use a scale from 1 to 5, where 1 being "very poor/low" and 5 being "excellent/very good".

Please circle the number to complete for this question.

Statement	Scale				
	Very Poor	Poor	Neither	Good	Very Good
Are the changes in the procedure of delivering teaching with mobile learning technology model desirable?	1	2	3	4	5
Are the changes in the procedure of delivering teaching with mobile learning technology model feasible?	1	2	3	4	5
Do the model changes fit the environment within the primary school?	1	2	3	4	5
Do the model changes make the use of mobile learning technology easier for teachers and easier for administrators to deliver MLT curriculum?	1	2	3	4	5

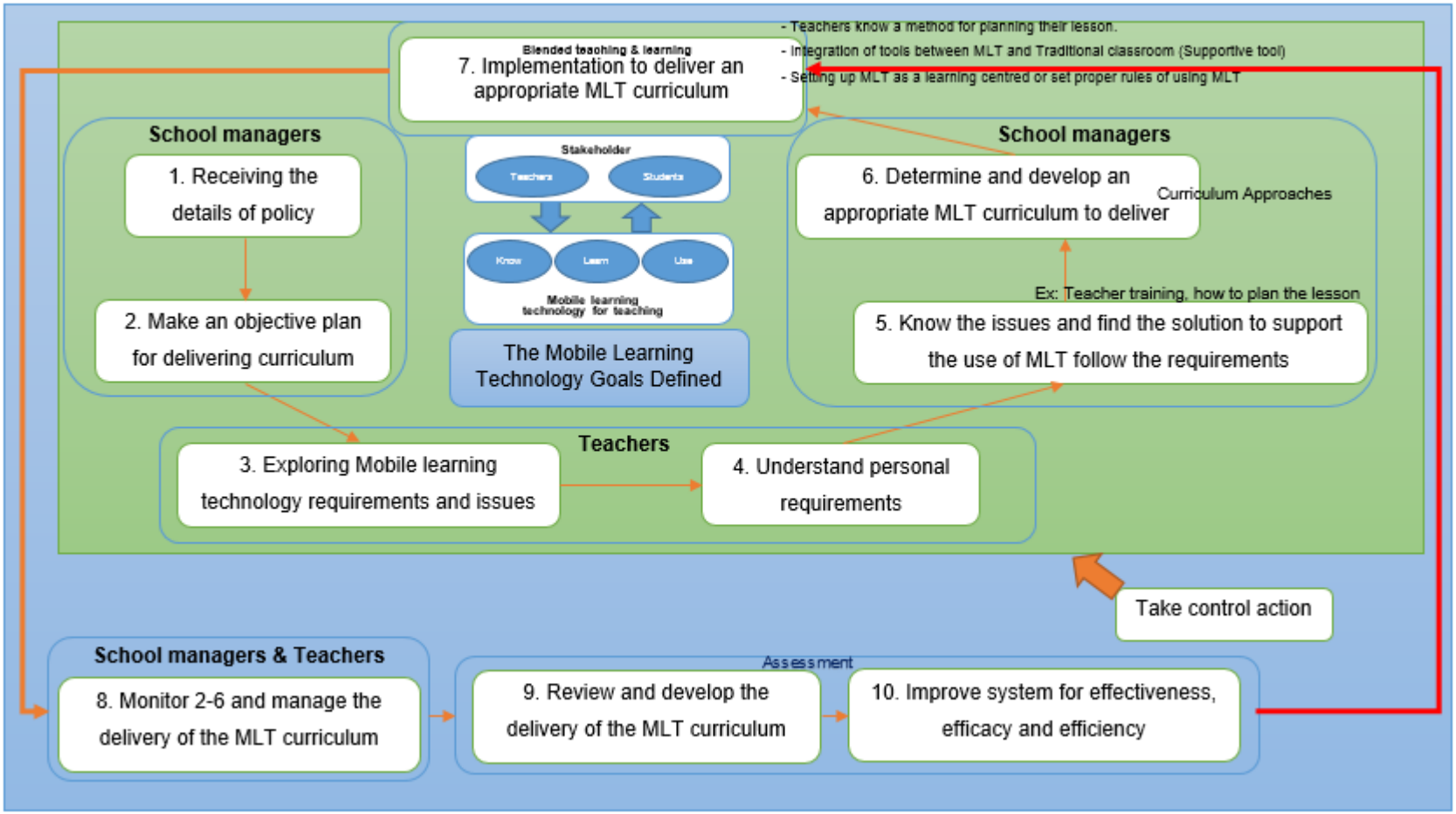
Appendix I: Questionnaire of the evaluation on desire and feasible of decision support model of mobile learning technology (Thai version)

แบบสอบถามการประเมินความต้องการและความเป็นไปได้ของกรอบรูปแบบแนวคิด

Mobile Learning Technology

แบบสอบถามฉบับนี้จัดทำขึ้นเพื่อทดสอบกรอบแนวคิดที่ถูกสร้างขึ้นเป็นไปตามความต้องการของครูและผู้บริหารโรงเรียนที่มีส่วนเกี่ยวข้องในระบบการศึกษา และรายงานเกี่ยวกับประสิทธิภาพในการจัดทำหลักสูตรในบริบทของการศึกษาระดับประถมศึกษาในพื้นที่ทรัพยากรที่ จำกัด

The Decision Support Model of Mobile Learning Technology



ก่อนทำการประเมิน โปรดดูรูปแบบข้างต้นเพื่อประเมินความเหมาะสมและความเป็นไปได้ของแบบจำลองสนับสนุนการตัดสินใจ (Decision Support Model).

1. ตำแหน่ง **(Position)**

☐ ผู้บริหารโรงเรียน (Executive of school) ☐ ครูผู้สอน (Teacher)

2. ข้อความในการประเมิน

กรุณาวงกลม ❍ ลงบนตัวเลขที่ตรงกับความคิดเห็นของท่านมากที่สุด
บนเลขสเกล 1-5: (1) อ่อนมาก, (2) อ่อน, (3) พอใช้, (4) ดี และ (5) ดีมาก

Statement	ระดับ				
	อ่อนมาก	อ่อน	พอใช้	ดี	ดีมาก
การเปลี่ยนแปลงในกระบวนการจัดส่งรูปแบบ Mobile Learning Technology เป็นที่น่าพึงพอใจหรือไม่?	1	2	3	4	5
การเปลี่ยนแปลงในกระบวนการจัดส่งรูปแบบ Mobile Learning Technology มีความเป็นไปได้หรือไม่	1	2	3	4	5
รูปแบบของการเปลี่ยนแปลงมีความเหมาะสมกับสภาพแวดล้อมภายในโรงเรียนประถมหรือไม่?	1	2	3	4	5
รูปแบบที่ทำการเปลี่ยนแปลงทำให้การใช้ Mobile Learning Technology ง่ายขึ้นสำหรับครูและผู้บริหารให้สามารถจัดส่งหลักสูตร MLT ได้ง่ายขึ้นหรือไม่?	1	2	3	4	5

Appendix J: SPSS Descriptive Statistics Calculations of the evaluation on desire and feasible of decision support model of mobile learning technology

Frequencies

Statistics

Position

N	Valid	27
	Missing	0
Mean		1.63
Std. Deviation		.492

Position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	School manager	10	37.0	37.0	37.0
	Teacher	17	63.0	63.0	100.0
	Total	27	100.0	100.0	

Frequencies

Statistics

		Are the changes in the procedure of delivering mobile learning technology desirable?	Are the changes in the procedure of delivering mobile learning technology feasible?	Does the changes fit the environment within the primary school?	Does the changes make the use of mobile learning technology easier for teachers to plan MLT lesson and easier for administrators to deliver MLT curriculum?
N	Valid	27	27	27	27
	Missing	0	0	0	0
Mean		3.93	4.11	4.19	4.30
Std. Deviation		.730	.698	.622	.609

Frequency Table

Are the changes in the procedure of delivering mobile learning technology desirable?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ok	8	29.6	29.6	29.6
	Good	13	48.1	48.1	77.8
	Very Good	6	22.2	22.2	100.0
	Total	27	100.0	100.0	

Are the changes in the procedure of delivering mobile learning technology feasible?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ok	5	18.5	18.5	18.5
	Good	14	51.9	51.9	70.4
	Very Good	8	29.6	29.6	100.0
	Total	27	100.0	100.0	

Does the changes fit the environment within the primary school?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ok	3	11.1	11.1	11.1
	Good	16	59.3	59.3	70.4
	Very Good	8	29.6	29.6	100.0
	Total	27	100.0	100.0	

Does the changes make the use of mobile learning technology easier for teachers to plan MLT lesson and easier for administrators to deliver MLT curriculum?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ok	2	7.4	7.4	7.4
	Good	15	55.6	55.6	63.0
	Very Good	10	37.0	37.0	100.0
	Total	27	100.0	100.0	